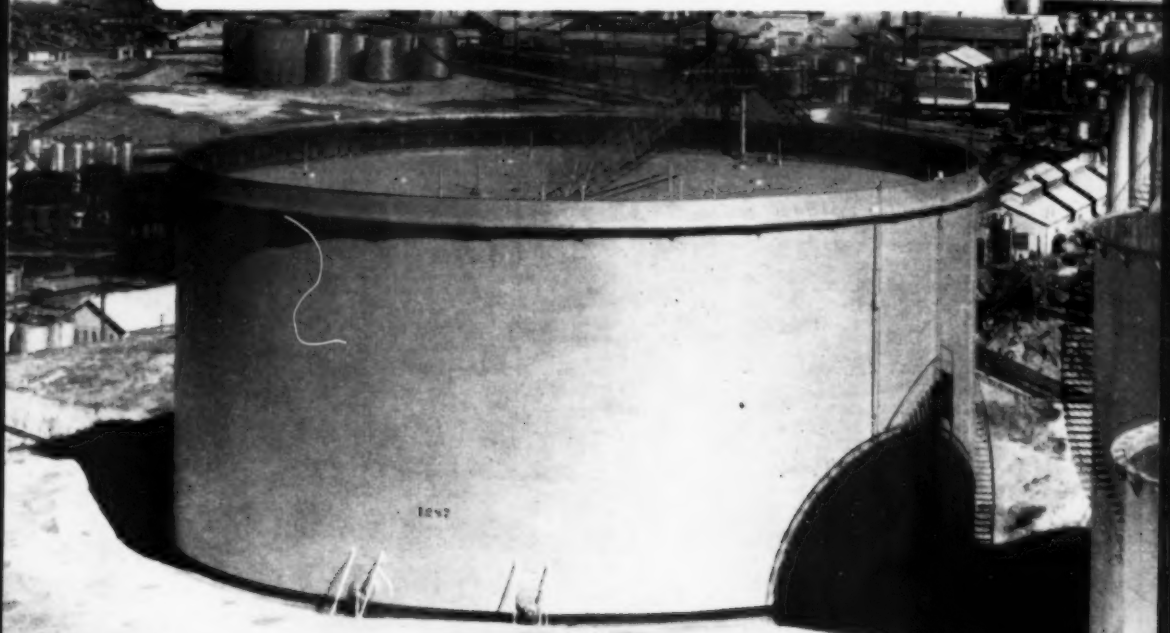
JULY, 1952

PETROLEUM REFINER

SPECIALIZED FOR REFINING, NATURAL GASOLINE AND PETROCHEMICAL ENGINEERING, OPERATION AND MANAGEMENT

THROUGHOUT the petroleum industry, modern storage tanks equipped with Horton Floating Roofs are reducing evaporation loss, corrosion and fire hazard. Floating directly on the surface, the entire bottom of the roof is normally in contact with the liquid in the tank. There is no air-vapor mixture above the liquid to be vented and lost. Fire hazard and corrosion are reduced as a result of the elimination of this vapor space.

Horton Floating Roofs are built in three types: (1) the Double-Deck Floating Roof which has a double-deck over the entire liquid surface, (2) the Pontoon type with an annular pontoon around the outer edge and a deck of single thickness over the center portion, (3) the Pan type with a single thickness of deck over the entire surface. To help select the roof most suitable for your operation, write our nearest office for Bulletin B.



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The BECKMAN PHASE EQUILIBRIUM COMPUTER

FREES valuable engineers from tedious calculations!

SOLVES flash equilibrium problems **20 TIMES** faster!

SAVES many days in getting refineries on stream!

SIMPLIFIES production reservoir analyses!

Vapor-liquid relationships are an important factor in the design and operation of many petroleum and petro-chemical processes. But the laborious, trial-and-error methods now used for solving such relationships are time-consuming, tedious and greatly limit the productive capacity of technically-trained personnel.

Now such equations can be solved quickly, accurately, economically with the new electronic Beckman Phase Equilibrium Computer.

What it does . . .

With this new Beckman advancement, a non-technical operator can solve complex flash equilibrium equations in three to four minutes as compared with as much as 1½ hours required by highly trained personnel using present trial-and-error calculating procedures.

The data—consisting of analyses of the feed, together with equilibrium constants for the given temperatures and pressures—is merely set into the machine by means of numbered decade dials.

A few dials are adjusted to balance the network, as indicated on a null-indicating meter, and the ratio of total liquid to total vapor is solved. Similarly, subsequent balances solve the liquid fraction of each constituent and the vapor feed ratio.

Accuracy for each constituent is within 0.05% of the total liquid, and as many as 10 feed constituents can be set into the machine at one time!

How it's used . . .

The Beckman Phase Equilibrium Computer is an invaluable aid in a wide range of applications . . .

- *In designing fractionators, absorbers and other refinery equipment, the interaction of gas and liquid phases with temperature and pressure variations throughout the columns can be quickly and accurately evaluated.*
- *Valuable time is saved in designing surface separator systems for optimum operating temperatures and pressures, assuring maximum recovery of the desirable constituents.*
- *In field production operations, the nature and amount of gas developed in the reservoir as pressures decline can be quickly and accurately determined . . . better gas/oil ratios can be maintained and optimum recovery obtained.*

The time saved in getting just *one* refinery job on stream can more than repay the cost of a Beckman Phase Equilibrium Computer . . . and the instrument continues saving time, cutting costs, boosting manpower efficiency year after year on a wide range of vapor-liquid computations. It will pay you to get the full story on this new Beckman advancement!

Send for Bulletin 12-25 which describes this instrument!

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control modern industries

SPECIAL PRODUCTS DIVISION
BECKMAN INSTRUMENTS, INC.
South Pasadena, California

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Specialized for Refining, Natural Gasoline and Petrochemical Engineering, Operation and Management

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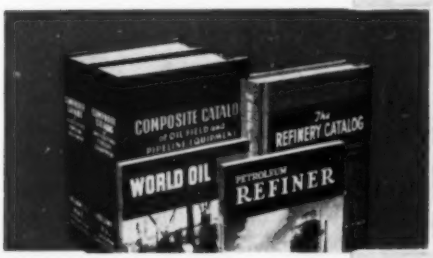

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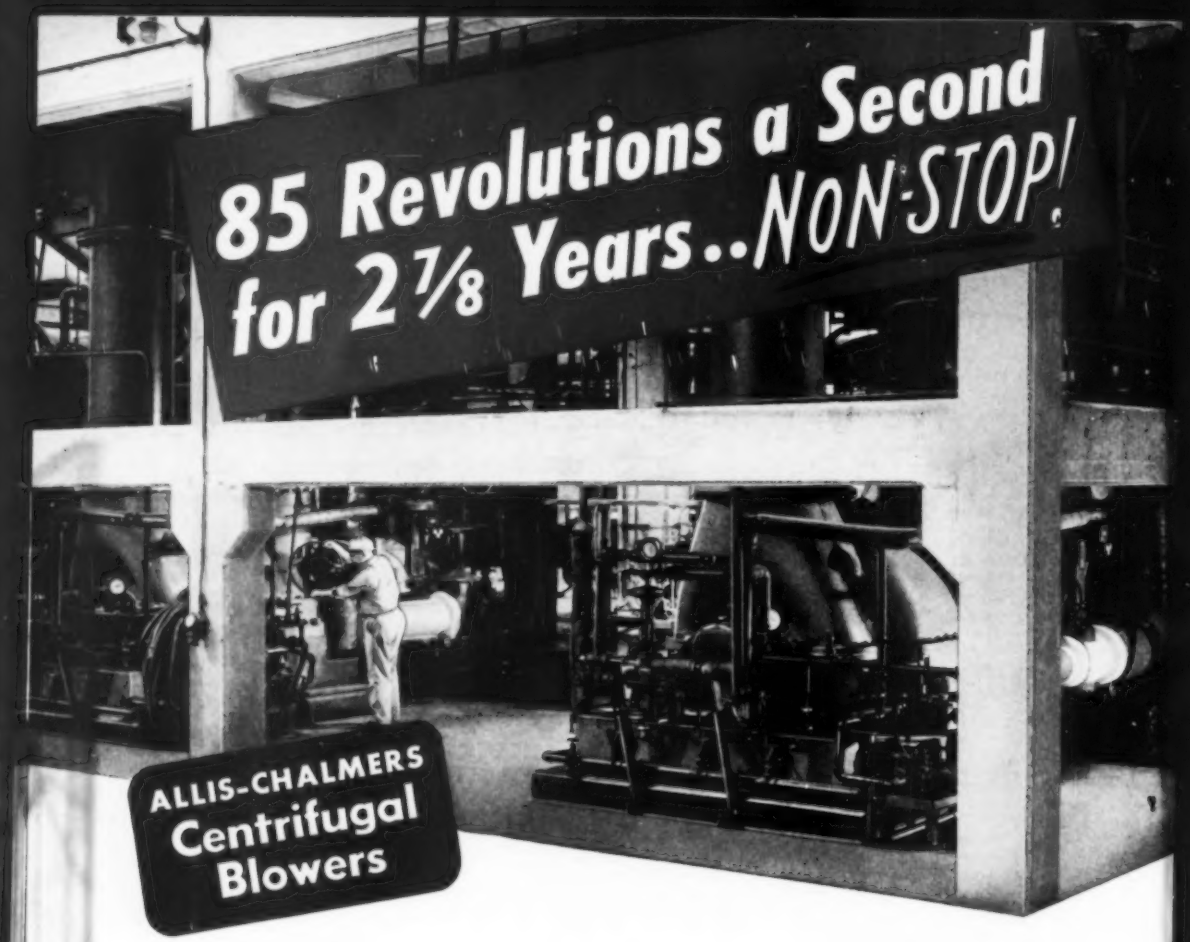

GIVE RECORD PERFORMANCE AT CITIES SERVICE REFINING CORPORATION

AROUND THE CLOCK fluid catalytic cracking service *demands* reliable equipment. Cities Service Refining Corporation at Lake Charles, La. depends on seven Allis-Chalmers centrifugal blowers for catalyst aeration . . . rated 22,500 cfm, 17 lb G at 5100 rpm.

Six of the seven were installed in 1943. Two proceeded to set a record of 540 days, 24 hours a day, continuous operation — being shut down only for drive inspection! Two others have since run for 1058 days before scheduled inspection shutdown! Only routine maintenance has been required.

These blowers are still on the job, 24 hours a day, helping produce motor, premium, aviation gasoline and other fuels for the widespread operations of Cities Service Refining Corporation. Output is at constant volume, maintained by variable speed steam turbines.

Here are the reasons for the low maintenance and high dependability of A-C centrifugal blowers:

PURE ROTARY MOTION — precisely balanced impeller is only moving part.
FRICTION FREE INTERIOR — bearings outside casing, no internal mechanical wear.
SIMPLE LUBRICATION—oil under pressure in closed circuit, consumption is low.
STRONG CONSTRUCTION — forged steel shaft, alloy impeller cuts unit size, weight.
CAST IRON CASING — cast construction makes blower rigid, smooth, quiet.
THOROUGH TESTING — maximum and severe over-speed tests given at factory.

For more information or literature on this kind of highly dependable, low maintenance air and gas handling equipment, call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wis. New Multi-Stage Bulletin 19B6104A now available.

ALLIS-CHALMERS

Texrope is an Allis-Chalmers trademark.

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TURBINE-GENERATORS | BLOWERS and COMPRESSORS | TRANS-FORMERS | UNIT SUBSTATIONS | MOTORS—*TEXROPE* DRIVES-CONTROL | CENTRIFUGAL PUMPS

Only THE PEERLESS *type* PR *Brings you...*

HEAVY-DUTY HIGH TEMPERATURE PROCESS PUMP FOR REFINERIES AND CHEMICAL PLANTS

PEERLESS PUMPS

1–MAXIMUM PARTS INTERCHANGEABILITY
2–RUGGED CENTER-LINE-MOUNT DESIGN
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5–AVAILABILITY IN VARIOUS ALLOY MATERIALS
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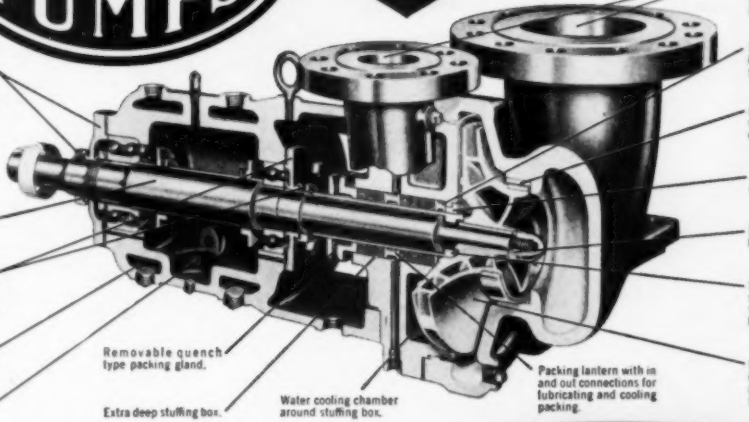
7–A COMPLETE RANGE OF SIZES

Plus ALL THESE IMPORTANT DESIGN AND CONSTRUCTION FEATURES!


Top suction and top discharge design. End-suction design available.
By-pass lantern to relieve stuffing box pressure back to suction.
Case and impeller wearing rings are spot electric welded.
Throat bushing is spot electric welded.
Lock washer secures hex nut on shaft.
Shaft sleeve keyed to shaft, gasketed at shaft shoulder to prevent leakage under sleeve.
Enclosed type impeller is keyed to shaft; re-pelling vanes on back shroud
Packing lantern with in and out connections for lubricating and cooling packing.
Water cooling chamber around stuffing box.
Extra deep stuffing box.
Removable quench type packing gland.
Extra large capacity oil reservoir.
Large water jacket for cooling oil & bearings.
Slinger and special recessed bearing cap provide an effective seal without wearing parts.
Heavy duty thrust and radial bearings oil-lubricated.
Precision alloy steel, heat-treated, shaft.
Slinger and special recessed bearing cap provide an effective seal without wearing parts.

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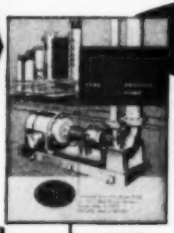

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PEERLESS PUMP DIVISION
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What one tube steel gives you the best life/cost ratio? Ask the experts!

This month the Timken Company reports on:

18-8 STAINLESS

An austenitic, non-magnetic alloy that shows the best combination of creep strength, oil corrosion resistance and oxidation resistance for service up to 1500° F. For use in oil cracking systems, hydrogenation equipment, high temperature oil and steam piping, superheater elements, heat exchangers.

ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

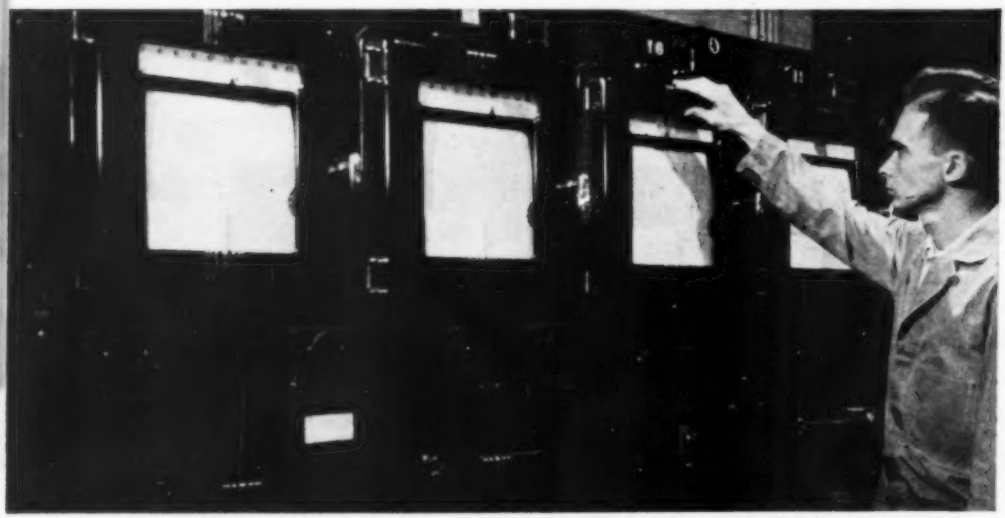
Carbon	Sicromo 2	Sicromo 5S	18-8 Ti
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20*
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6**

**Available as seamless tubing on an experimental basis only.*
***Not available as seamless tubing.*

YOU probably can find several high temperature steels that are adaptable to your particular heat, pressure, oxidation and corrosion conditions. But there's only *one* steel that will give you maximum tube life per dollar—the best life/cost ratio.

To get the one tube steel that's best for you, whether it's one of 8 analyses of stainless or one of 16 other analyses, call on the Timken Company's metallurgists. They're recognized authorities on high temperature steels. With 25 years' experience in steel development and with 24 different analyses to choose from, they can help you select the one steel that gives you the most for your tube dollar.

The Timken Company is one of the oldest producers of stainless and other high temperature steels in the country. Let our "RSQ"—Research, Supply, Quality—solve your tube problems. *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".



One reason for the Timken Company's leadership in high temperature steels is never-ending research. Photo shows the instruments which control the furnaces used in determining proper heat treatment for high temperature steels.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

CHECK THESE 3 WAYS YOU CAN SAVE WITH THIS MULTI-PURPOSE INSTRUMENT

Here is the most sensible idea you've ever seen in a recorder or controller—an instrument you can change as your instrument needs change, that you can add to, subtract from, or whose functions you can increase or decrease at little or no expense.

✓ **Save money when you add new functions by adding only those new assemblies needed.**

✓ **Save time-delays by making changes on the job site without returning to factory.**

✓ **Save money on inventory. Parts are interchangeable, fit all Gotham Convertible recorders. You can service a whole group with a minimum stock of basic elements.**

What you can do with the Gotham Convertible

Depending on the chart size of the recorder (6″, 9″ or 12″) you can have a 1-2-3 or 4 pen recorder with 14 pressure, temperature and time operation combinations or a recorder-controller with 38 possible pressure, temperature, and time combinations.

SELF-CONTAINED PORTABLE RECORDER

A portable recorder which has a carrying handle, legs and retaining holder for capillary and bulb. Built from Gotham standard elements, interchangeable with other Gotham instruments. 6", 9" and 12" chart sizes. Mercury, Vapor or Pressure Activated. Spring or electric chart drive. See Catalog 400.

RECORDING PSYCHROMETER

Incorporates the same highly accurate and responsive thermal systems and contains all other Gotham standard convertible features. Wet and dry bulb type. Motor-driven suction fan. 12" chart size. Catalog 400.

RECORDING HYGROMETER

A 2-pen recorder of the wet and dry bulb type. Mercury or Vapor Actuated. 9" and 12" chart sizes. Available with variety of wet and dry bulb assemblies depending on application. Catalog 400.

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- ☐ Catalog 200—Dial Type Thermometers
- ☐ Catalog 400—Recorders, Psychrometers, Hygrometers
- ☐ Catalog 500—Controllers
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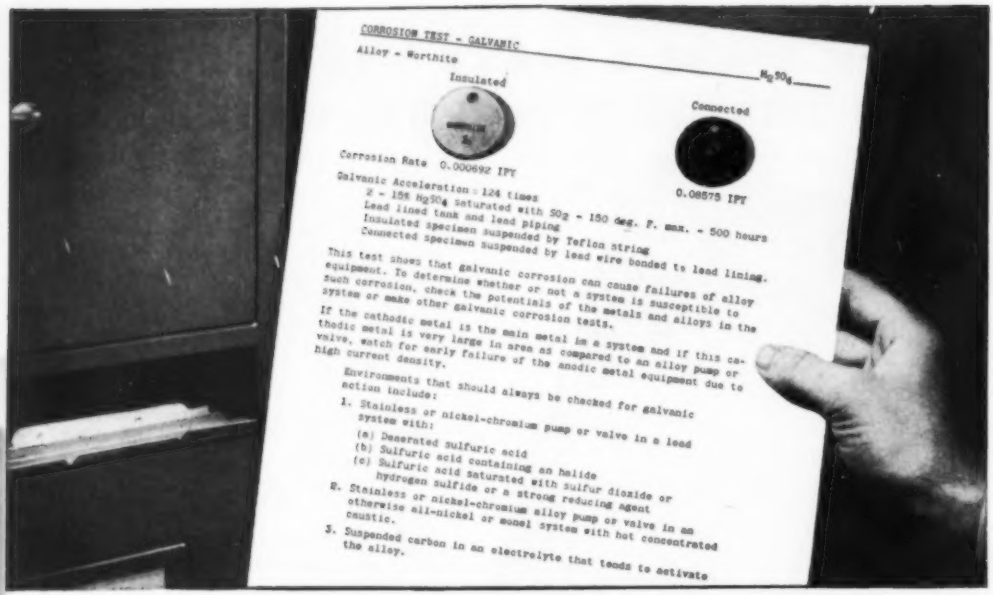

CORROSION TEST - GALVANIC
Alloy - Worthite
H_2SO_4
Insulated
Connected
Corrosion Rate 0.000692 IPY
0.08575 IPY
Galvanic Acceleration = 124 times
2 - 15% H_2SO_4 saturated with SO_2 - 150 deg. F. max. - 500 hours
Lead lined tank and lead piping
Insulated specimen suspended by Teflon string
Connected specimen suspended by lead wire bonded to lead lining.
This test shows that galvanic corrosion can cause failures of alloy equipment. To determine whether or not a system is susceptible to such corrosion, check the potentials of the metals and alloys in the system or make other galvanic corrosion tests.
If the cathodic metal is the main metal in a system and if this cathodic metal is very large in area as compared to an alloy pump or valve, watch for early failure of the anodic metal equipment due to high current density.
Environments that should always be checked for galvanic action include:
1. Stainless or nickel-chromium pump or valve in a lead system with:
(a) Deaerated sulfuric acid
(b) Sulfuric acid containing an halide
(c) Sulfuric acid saturated with sulfur dioxide or hydrogen sulfide or a strong reducing agent
2. Stainless or nickel-chromium alloy pump or valve in an otherwise all-nickel or monel system with hot concentrated caustic.
3. Suspended carbon in an electrolyte that tends to activate the alloy.

A CASE STUDY FROM THE WORTHINGTON FILES. This Worthington test sheet indicates that the galvanic action could be virtually eliminated in this manufacturer's system by *insulation*—that is, a complete separation of the alloy pump from metallic contact with lead surfaces. The recommendation was made to him as a result of a Worthington test made on the solutions his system was pumping.

It Takes More Than A Pump To Solve A Pumping Problem!

Worthington's files are packed with many stories like this one. Each is proof positive that you get a lot more than a Worthite* pump when you buy from Worthington.

It was the age-old problem of chemical pumping, corrosion. But this customer found a way out—a *practical solution* that saved him plenty of expense in extra maintenance and lost production time.

He wrote a letter to Worthington. Could we tell him whether there was anything he could do to slow down or stop this corrosion? He was pumping a 15% solution of sulfuric acid saturated with sulfur dioxide. Maximum temperature of solution was 150° F.

This wasn't a new problem for Worthington corrosion specialists. Experience had shown them that under these conditions galvanic action could be his trouble. They ran the test illustrated above which conclusively proved these assumptions correct.

Result? The customer insulated the system and his troublesome corrosion problem was brought under control.

At Worthington, we welcome the chance to hear about *your* pumping problems—either on a present installation or in the design of a new system. For it is only through such close contact with the industry that we can continue to build the kind of pumps and offer the kind of services that have led pump users the world over to the conclusion that *there's more worth in Worthington.*

Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.

*Reg. U. S. Pat. Off. C.1.6

Types CG and CGL. Sizes ¾" to 10". Capacities to 5000 GPM, heads to 200 ft. Liquid ends of WORTHITE.

Type CF. Sizes 1" to 4". Capacities to 1000 GPM, heads to 130 ft. Standard, all iron and all bronze.

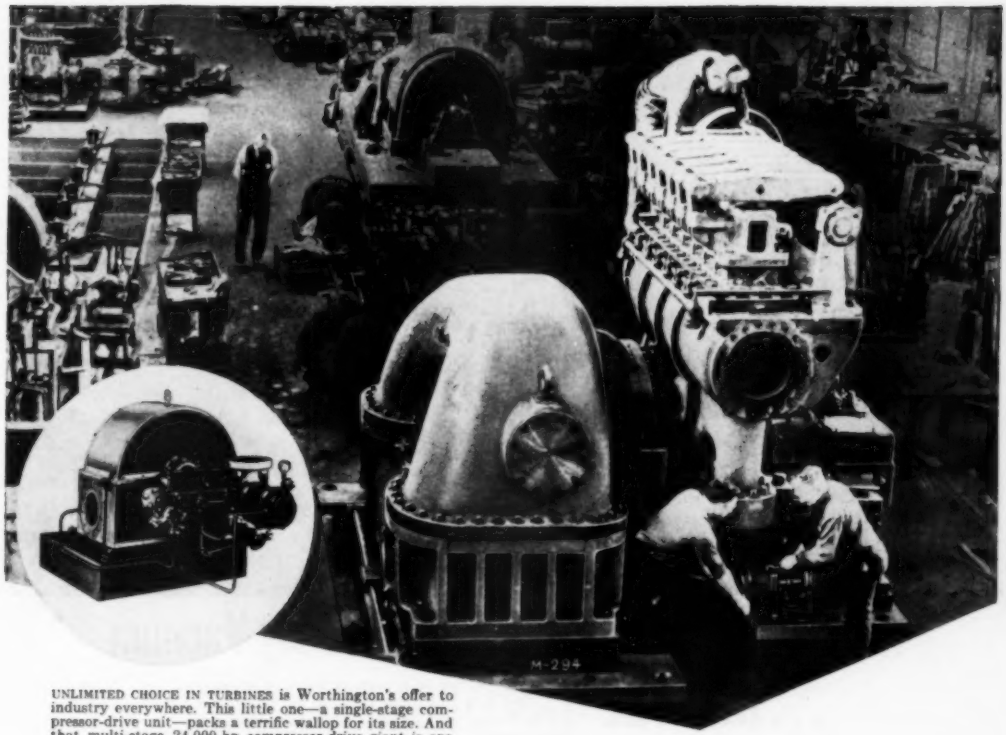
Type CQ. Sizes 1½" to 3". Capacities to 600 GPM, heads to 130 ft. at 1750 RPM. Closed impeller.

Type L. Sizes 3" to 8". Capacities to 2250 GPM, heads to 300 ft. Single stage volute. For general service.

WORTHINGTON

Centrifugal Pumps

The World's Broadest Line Assures You the Right Pump for Every Job



UNLIMITED CHOICE IN TURBINES is Worthington's offer to industry everywhere. This little one—a single-stage compressor-drive unit—packs a terrific wallop for its size. And that multi-stage 24,000-hp compressor-drive giant is one of the largest ever built for this type of service.

Single-stage midgets to multi-stage giants

Whether your turbine requirements call for the biggest or the smallest—straight condensing . . . straight non-condensing . . . extraction . . . mixed pressure extraction . . . low pressure . . . high back pressure . . . for mechanical or generator drive . . . with governors for constant or variable speed—*Worthington has an answer.*

Each Worthington turbine is designed to make the steam do *more* work, so you save power and money throughout its long life.

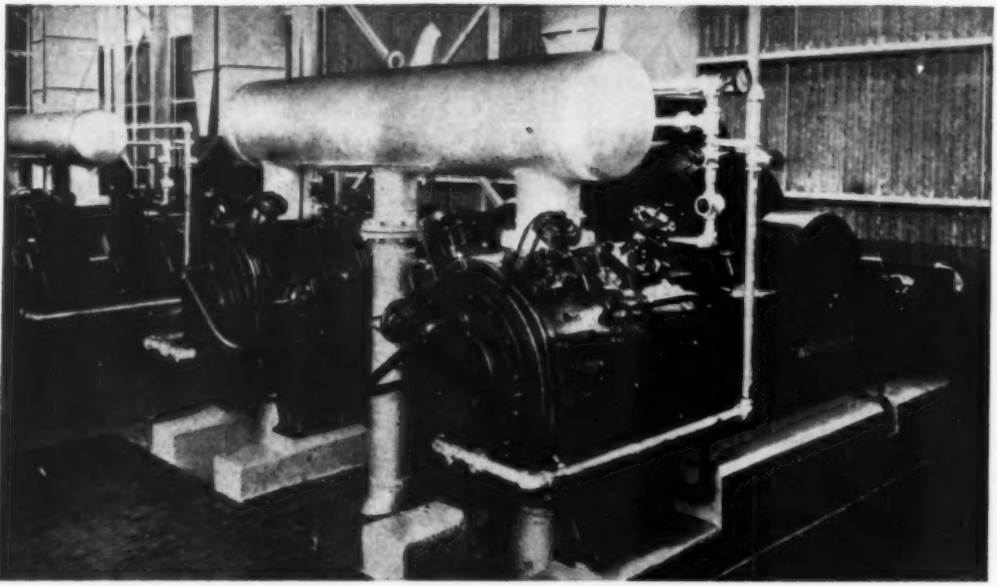
Learn more about Worthington turbines. Get the facts on why *there's more worth in Worthington* by writing to Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.

T.2.2

A GREAT TEAM IN STEAM

WORTHINGTON

Steam Turbines



A New Cracking System at Socony-Vacuum ...BUT THE SAME COMPRESSORS

When Socony-Vacuum needed to modernize its catalytic cracking plant in Buffalo, it put in the thermofor process.

To compress hydrocarbons for the process, Socony-Vacuum selected Worthington DC compressors. Why?

Because—the three Worthington compressors on the old Houdry system performed successfully . . . since 1939.

So . . . in addition to these three, Socony-Vacuum now has four more compressors working on the Thermofor unit. One of these four (not shown in the picture) is a 4-cylinder tandem compressor with a unique control system permitting it to operate on either low or high pressure service.

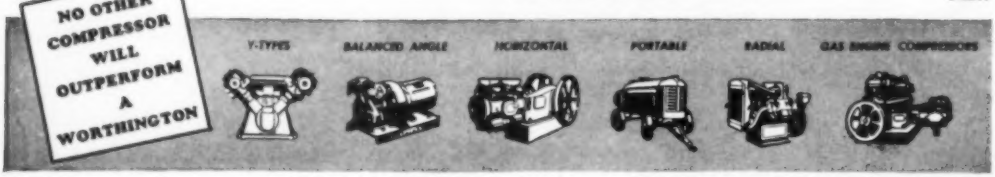
This case illustrates not only the *dependability* of Worthington compressors but also the *adaptability* of the Worthington line to all refinery requirements—all types of gases, all pressures, all capacities. In addition, Worthington provides the broadest line of pumps, engines, refrigeration equipment and other petroleum processing machinery.

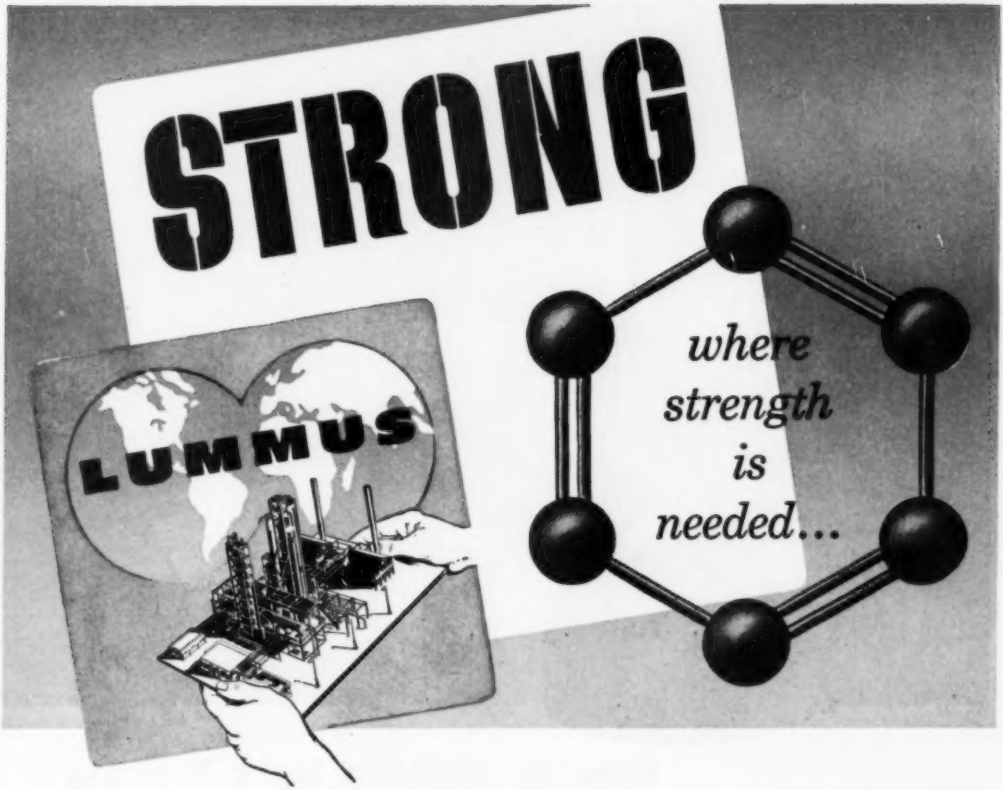
Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, New York.

WORTHINGTON

COMPRESSORS

24K1.4





The Lummus Company has played an integral and important role in the unfolding story of chemical progress.

Evidence? You'll find it all over the globe in the form of chemical processing units designed, engineered and constructed by The Lummus Company—plants whose initial run met or exceeded design capacity and never relaxed in performance.

Examples? Lummus has designed and built nearly 350 chemical processing units, included among which are plants for producing phenol, resins, solvents, asphalts, alcohol, acetone, toluol, ammonium picrate, and for manufacturing catalysts. We were at the forefront in providing huge styrene and butadiene plants to feed the vast synthetic rubber program. In providing ethylene manufacturing facilities, the name Lummus looms biggest of all.

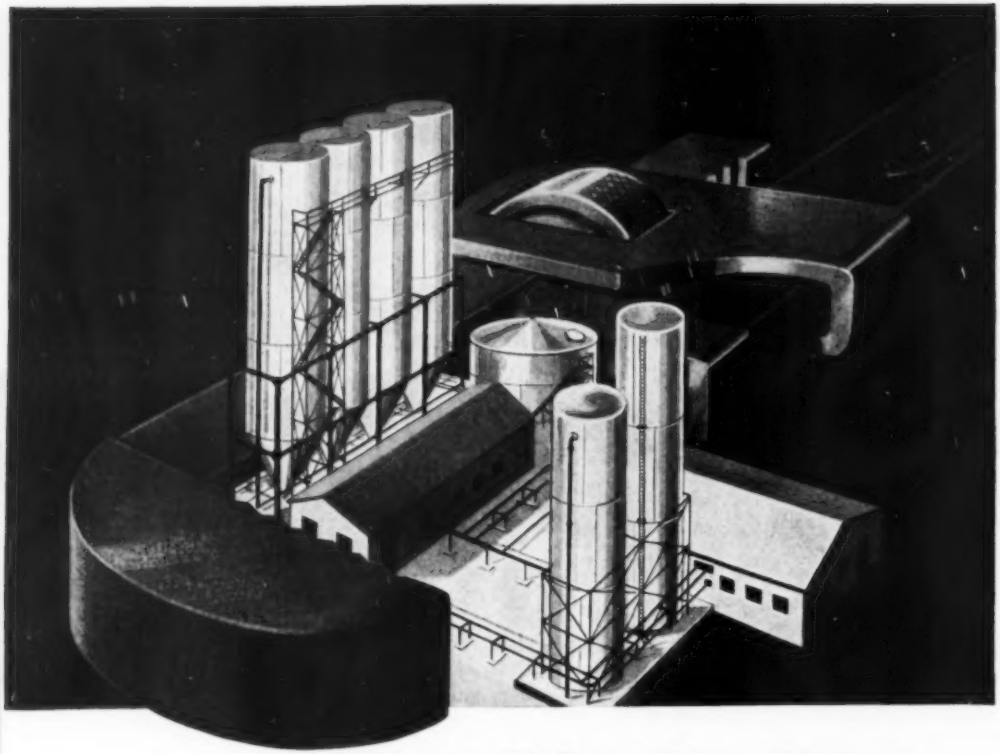
May we suggest our symbol as a good one to look for, believe in, and rely on in connection with your next chemical processing project? You'll find us to be a group with the depth of chemical engineering talent and the breadth of experience to tackle engineering and construction problems anywhere in the world.

THE LUMMUS COMPANY

385 MADISON AVENUE, NEW YORK 17, N. Y.

HOUSTON • CHICAGO • LONDON • PARIS • CARACAS

DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES



How to Tighten Up a Process When the Profits Work Loose

Can your operation bring more income? Probably. Most can. Here's how a refiner handling sour crudes went about it. He wanted economical flashing of a lube cut at 750°F to a furfural refining stock.

He got it with a stainless-clad steel flash tower built for semi-automatic operation. The design economically assures resistance to thermal shock, protects against elevated temperature corrosion and provides necessary strength and rigidity.

This refiner got continual throughputs of 20,000 barrels a day with long on-stream service. Other design bonuses were low maintenance, long life, reduced manpower needs.

Peak equipment values like this are the result of cooperative development between the engineering staffs of progressive Equipment Builders, process engineers and material suppliers. In developing such equipment, these experienced builders regularly turn to Lukens for its knowledge of materials, as well as its wide range of specialty steel plate, heads and steel plate shapes providing essential design freedom, strength and rigidity.

Get this attention for your operation. For names of Equipment Builders who can help you, write us today, explaining your need. Manager Marketing Service, 404 Lukens Building, Coatesville, Pennsylvania

LUKENS

LUKENS STEEL COMPANY

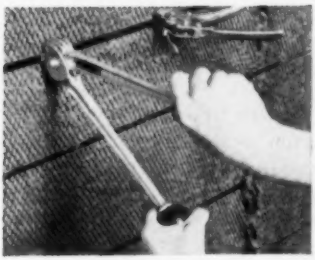
WORLD'S LEADING PRODUCER OF SPECIALTY STEEL PLATE · PLATE SHAPES · HEADS · CLAD STEELS

EAGLE PICHER Insulations

Carefully designed to fit your needs, to save you time, power, money

SUPERTEMP BLOCKS

These are efficient insulating blocks manufactured from Eagle-Picher High Temperature Mineral Wool. They derive low thermal conductivity, high refractory value, and outstanding chemical and physical stability from this basic insulating material. Weight is approx. 22 to 24 lbs. per cu. ft. Designed for temperatures up to 1700 F.

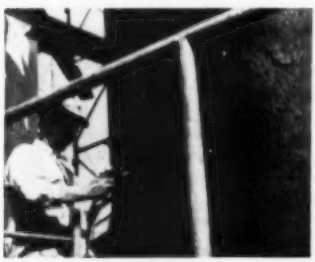


MINERAL WOOL BLANKETS

The answer to the problem of quickly and efficiently insulating flat or curved surfaces on larger types of heated equipment. Factory-made, these blankets are certified to meet rigid high standard specifications, offer unexcelled uniformity of mineral wool distribution. Withstand continuous exposure to temperatures as high as 1200 F. . . . offer maximum water repellence . . . resistance to steam, corrosive fumes, normal vibration.

SUPER "66" INSULATING CEMENT

A rust-inhibitive, super-adhesive insulating cement . . . offers exceptional coverage, extreme thermal efficiency. "Springy ball" structure—with small resilient pellets, each containing thousands of "dead" air cells—provides one of the most effective heat barriers known. Easily trowelled over all kinds of surfaces. Efficient up to 1800 F. . . . reclaimable where temperatures don't exceed 1200 F. Can be applied to any heated equipment.



STAMASTIC

This specially formulated weather-proofed coating forms an efficient vapor barrier . . . has strong resistance to cracking or hardening caused by temperature changes. Impervious to most acids, alkalies and chemical fumes. Heat resistant up to 300 F. Easily sprayed or trowelled over all standard types of insulation, steel, iron and other building materials.

MAXIMUM FUEL SAVINGS AND EXACT TEMPERATURE CONTROL WITH THESE EAGLE-PICHER INSULATIONS:

• Insulating Felts • Supertemp Block • Blankets • Loose Wool • Pipe Covering • Stalastic • Stamastic • Insulseal • Finishing Cements • Insulating Cements • Fireproofing Cement • Swetchek • Diatomaceous Earth Block.

EAGLE EP PICHER

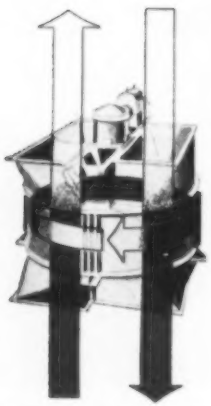
THE EAGLE-PICHER COMPANY *Since 1843*

GENERAL OFFICES: CINCINNATI (1), OHIO

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

Replace Still Convection Surfaces...

...with a Ljungstrom Air Preheater



The Ljungstrom operates on the continuous regenerative counter-flow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

In purchasing new equipment—or modernizing existing equipment—one way to save impressive amounts of capital as well as operating expense is to design for a Ljungstrom Air Preheater.

Because the Ljungstrom promotes such greatly increased heat liberation in the furnace, the convection bank of oil tubes can generally be eliminated from the design. This can in itself *more than pay the cost of the Ljungstrom installation.*

Add to this the proved fuel savings . . . the higher product quality . . . greater throughput possible with a Ljungstrom—and you will see why the Ljungstrom is an eminently practical piece of equipment to be considered wherever fuel is burned.

In these days of high fuel costs and skyrocketing demands for petroleum products, every refinery should consider a Ljungstrom whenever equipment is being purchased or modernized. Call or write The Air Preheater Corporation for complete details.

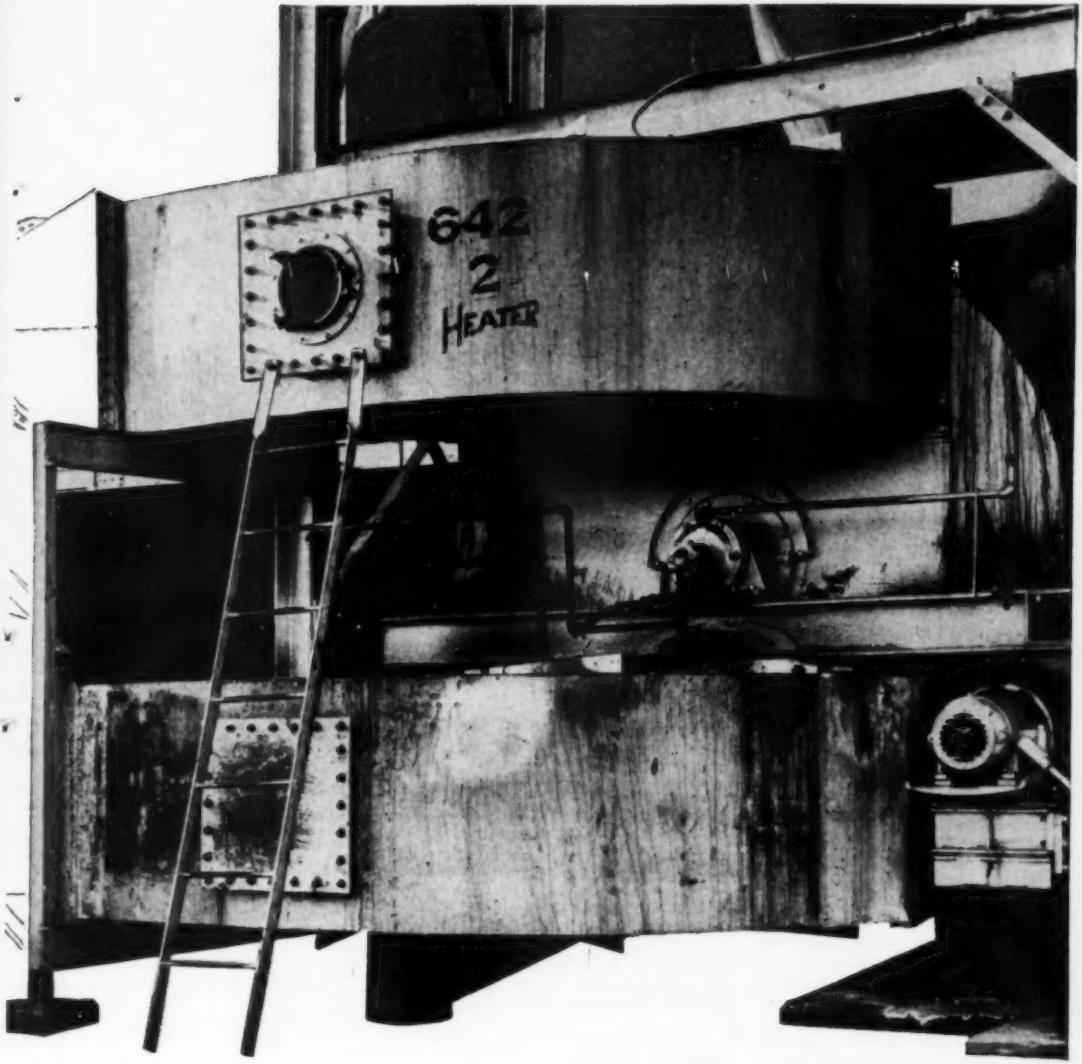
Wherever You Burn Fuel, You Need Ljungstrom

Refineries Now Using the Ljungstrom Air Preheater on One or More Process Units . . .

Continental Oil Company
Interocean Oil Company
Le Conselho Nacional de Petroleo Ref.
Lion Oil Company • Ohio Oil Company
Richfield Oil Corporation
Sinclair Refining Company
Socony Vacuum Oil Company
Standard Oil Company of California
Standard Oil Company of New Jersey

The Ljungstrom is no stranger to refineries. For years it has been a standard item for utilizing waste heat from power and process steam boilers. These refiners now use Ljungstrom Air Preheaters on steam boilers . . .

Cit-Con Oil Corporation • Continental Oil Corporation
Esso Standard Oil Company • Humble Oil & Refining Company
Magnolia Petroleum Corporation • Pan-American Refining Company
Phillips Petroleum Company • Shell Oil Company
Standard Oil Company of Indiana
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey • The Pure Oil Company
The Texas Company • Tidewater Associated Oil Company
Wilshire Oil Company



Consider Ljungstrom Air Preheaters for . . .

Catalytic Cracking
Coking
Petrochemical Production
Petrochemical Separation
Petrochemical Synthesis
Polyforming
Propane Deasphalting
Reforming
Solvent Refining
Thermal Cracking
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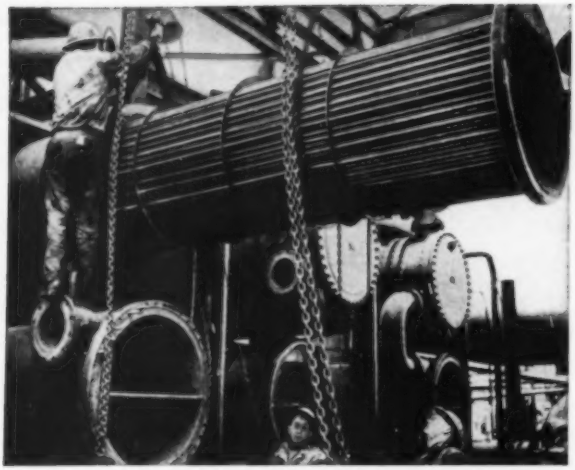
THE AIR PREHEATER CORPORATION
60 East 42nd Street, New York 17, N. Y.



A cleaned exchanger tube bundle being replaced in its shell. "Spring-cleaning" like this prevents failures in service and insures efficient heat exchange. Photo courtesy The M. W. Kellogg Co., New York, N. Y.

For stronger, lighter, longer-lasting heat exchangers, you can depend on Monel

New interpretations of the A.S.M.E. Boiler Code have raised temperature limits on Inco Nickel Alloys.

Now it is possible to use stress-relieved corrosion-resisting Monel with its high mechanical properties for unfired pressure vessels operating at high temperatures.

Here's what one user discovered about Monel:

The tubes were exposed to straight run gasoline distillate on the shell side and a heavy re-cycle inside. The highest temperature was 550° F. Previous materials had failed after only 6665 hours. But Monel had a different story. After 22,000 hours, 24 tubes needed to be replaced. And at 38,535 hours, 3 tubes were plugged—*the remainder were still good for additional service!*

Compare the hours of service and you can easily see why Monel is first choice for long life.

Of course, with so much Monel and other Inco Nickel Alloys needed for defense, orders now take longer for delivery. But there are ways you can keep your production rolling even in times like these.

First, as you know, equipment should receive extra attention now so that trouble can be checked before it advances too far.

Secondly, anticipate your replacement requirements and order well in advance. *And be sure to include N.P.A. ratings* with full end use information. These precautions will help expedite your order.

And above all, keep in touch with your Warehouse and Service Center. They are anxious to help with all your metal problems. Remember, their knowledge of metals and availabilities may help you with tough production difficulties.

All the Warehouse and Service Centers listed here handle the Inco Nickel Alloys. Just write to the one nearest you — or better still, pick up the phone and call.

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street, New York 5, N. Y.

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NICKEL (INCO) **ALLOYS**

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL
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STEEL SALES CORPORATION

LOS ANGELES 21
PACIFIC METALS COMPANY, LTD.

MEXICO, MEXICO, D. F.
LA PALOMA COMPANIA DE METALES, S. A.

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EAGLE METALS COMPANY

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STEEL SALES CORPORATION

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SEATTLE 4
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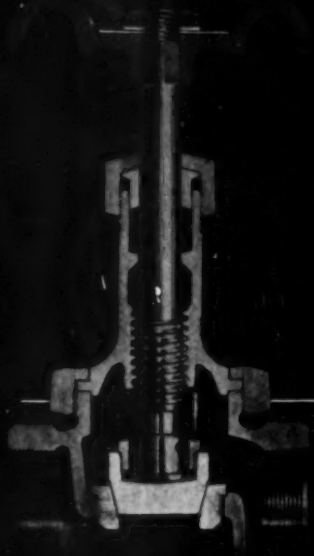


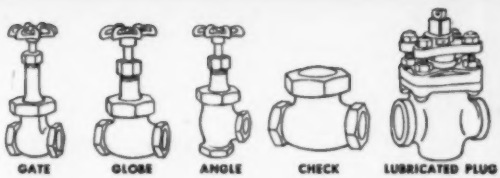
BRONZE

COMPLETE LINES OF BRONZE VALVES AND PIPE FITTINGS are manufactured by Walworth in a variety of types, pressure ratings, sizes, and patterns, including Walseal® Bronze Valves and Fittings for making Silbraz® joints.

Walworth also manufactures complete lines of valves and fittings – including Lubricated Plug Valves – made of steel, iron, and special alloys as well as bronze.

Walworth-made valves, pipe fittings, and pipe wrenches, total approximately 50,000 items—all sold through distributors in principal centers throughout the world.

Let Walworth engineers help you with your problems. For full information call your local distributor, nearest Walworth sales office, or write to Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.



Bronze valves in gate, globe, angle, check, and lubricated plug types are manufactured by Walworth. Illustrated is a sectional view of a Walworth No. 225P Bronze Globe Valve. This valve has a working steam pressure rating of 350 psi at 550F (1,000 psi non-shock cold water, oil, and gas pressure). It features a renewable, plug type, stainless steel seat and disc, heat treated to 500 Brinell hardness.

WALWORTH

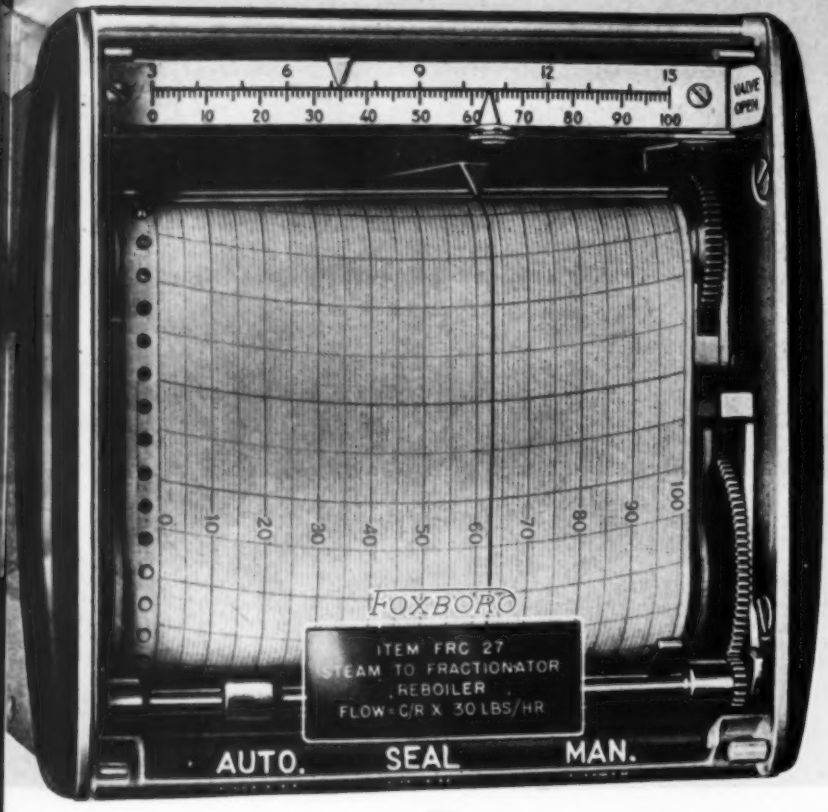
valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

Graphic Panel Instrumentation

CONSO



NEW M/53 CONSOTROL RECORDER PROVIDES 4 BETTER RECORDING-CONTROLLING SYSTEMS...

- **FULL-SCALE CHARTS** — Full 4" scale length. 30-day strip chart. Five hours of record always visible.
- **SINGLE SWITCH AUTOMATIC-MANUAL TRANSFER**
- **NO SET KNOBS** — All settings lever-operated.
- **CONTINUOUS VALVE-POSITION INDICATOR**
- **POSITIVE CONTROL SET-POINT** — Cannot drift. Maintained by precision pressure transmitter.
- **SECOND PEN OPTIONAL** — for extra non-controlled variable without compromising other features.

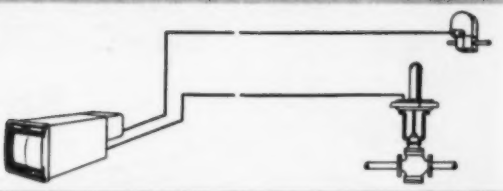
Single and 2-pen recorders, without control features, also available.

"comes of age"... in

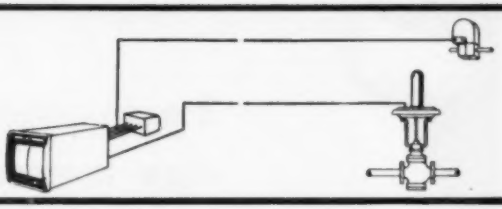
TROL

Recording-Controlling INSTRUMENTS

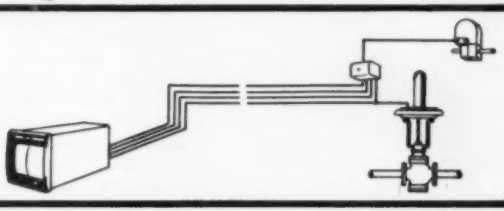
1 **Consotrol Recorder with M/58 Consotrol Controller... integrally-mounted**



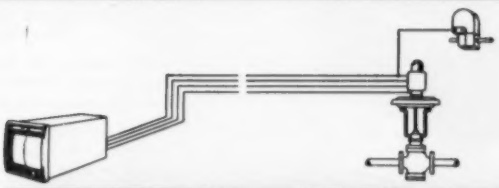
2 **Consotrol Recorder with M/58 Consotrol Controller... rack-mounted**



3 **Consotrol Recorder with M/58 Consotrol Controller... field-mounted**



4 **Consotrol Recorder with valve-mounted M/59 Consotrol Controller.**



New in concept . . . new in principle . . . Foxboro Consotrol Instruments combine amazing new convenience and accuracy with extreme compactness. Their simplicity and flexibility permit users to apply them to virtually any modern process requirement!

The unique versatility of the new Consotrol M/53 Recorder is outlined on these pages. Write for new Bulletin 463 containing details of the complete Consotrol line . . . recorders, "blind" receiver-controllers and indicating receiver-controllers.

The Foxboro Company, 747 Neponset Ave., Foxboro, Mass., U.S.A.

FOXBORO

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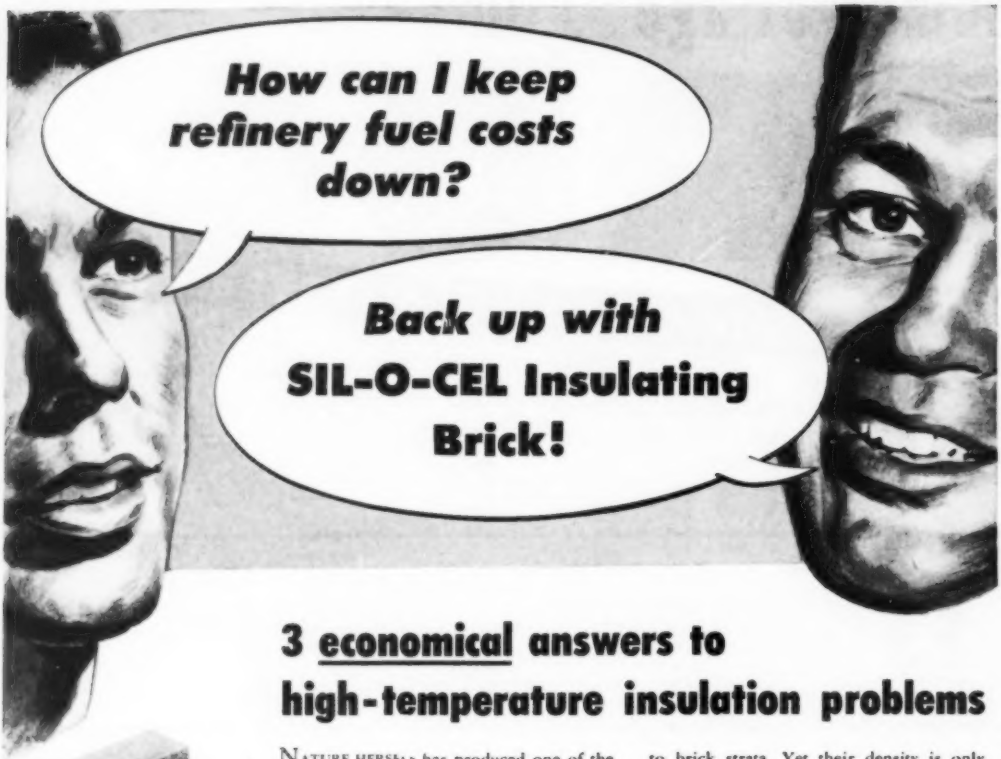
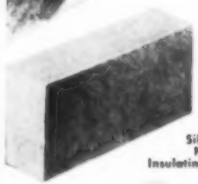
INSTRUMENTS

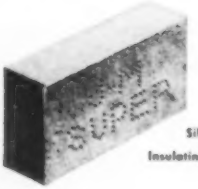
Recording · Controlling · Indicating



3 economical answers to high-temperature insulation problems


Sil-O-Cel Natural Insulating Brick

Sil-O-Cel C-22 Insulating Brick



Sil-O-Cel Super Insulating Brick

NATURE HERSELF has produced one of the most effective high-temperature insulating materials ever discovered—diatomaceous silica, from which Sil-O-Cel® Insulating Brick are made.

These insulating brick are used for back-up insulation behind fire brick or insulating fire brick linings in boilers, stills, stacks, reactor chambers, regenerators, heaters, flues, retorts, and other types of high-temperature equipment.

Sil-O-Cel Insulating Brick have excellent insulating qualities combined with high load-bearing characteristics and light weight.

Made in all standard shapes of the 2½ in. and 3 in. series, Sil-O-Cel Insulating Brick are produced in three basic types:

SIL-O-CEL NATURAL INSULATING BRICK
for temperatures to 1600F

Quarried directly from one of the world's purest deposits of diatomaceous silica, these insulating brick have a conductivity of only 0.79 Btu in./sq ft/F/hr at 1000F mean temperature, with heat flow perpendicular to brick strata. Yet their density is only 30 lb/cu ft. Cold crushing strength, 400 psi.

SIL-O-CEL C-22 INSULATING BRICK
for temperatures to 2000F

Ideal where high load-bearing properties are needed, this type of Sil-O-Cel is calcined, and has a cold crushing strength of 700 psi. Conductivity is 1.88 Btu in./sq ft/F/hr at 1000F mean temperature. Density, 38 lb/cu ft.

SIL-O-CEL SUPER INSULATING BRICK
for temperatures to 2500F

A calcined insulating brick for unusually high temperatures. In many cases, it is also possible to save on construction costs by reducing the thickness of fire brick or insulating fire brick when backed with Sil-O-Cel Super Insulating Brick. Conductivity is 1.95 Btu in./sq ft/F/hr at 1000F mean temperature. Density, 40 lb./cu. ft. Cold crushing strength, 300 psi.

For further information, write to Johns-Manville, Box 60, New York, N. Y. In Canada, write 199 Bay St., Toronto 1, Ont.

JOHNS MANVILLE JM PRODUCTS **Johns-Manville** *first in* **INSULATIONS**

WeldELLS®

...have set their own standards

Many of the largest users of Welding fittings refuse to accept any other fittings than WeldELLS.

They have found that when the name, WeldELL, is stamped into a fitting, that fitting can be accepted without question for any service for which it is designed.

They have found that WeldELLS have features that please both the men who design and the men who erect welded piping . . . features that were pioneered by Taylor Forge . . . features that are combined in no other welding fittings.

They have found the answer to their every need in the greater range of sizes, weights and types of the WeldELL line . . . in the broader scope of materials.

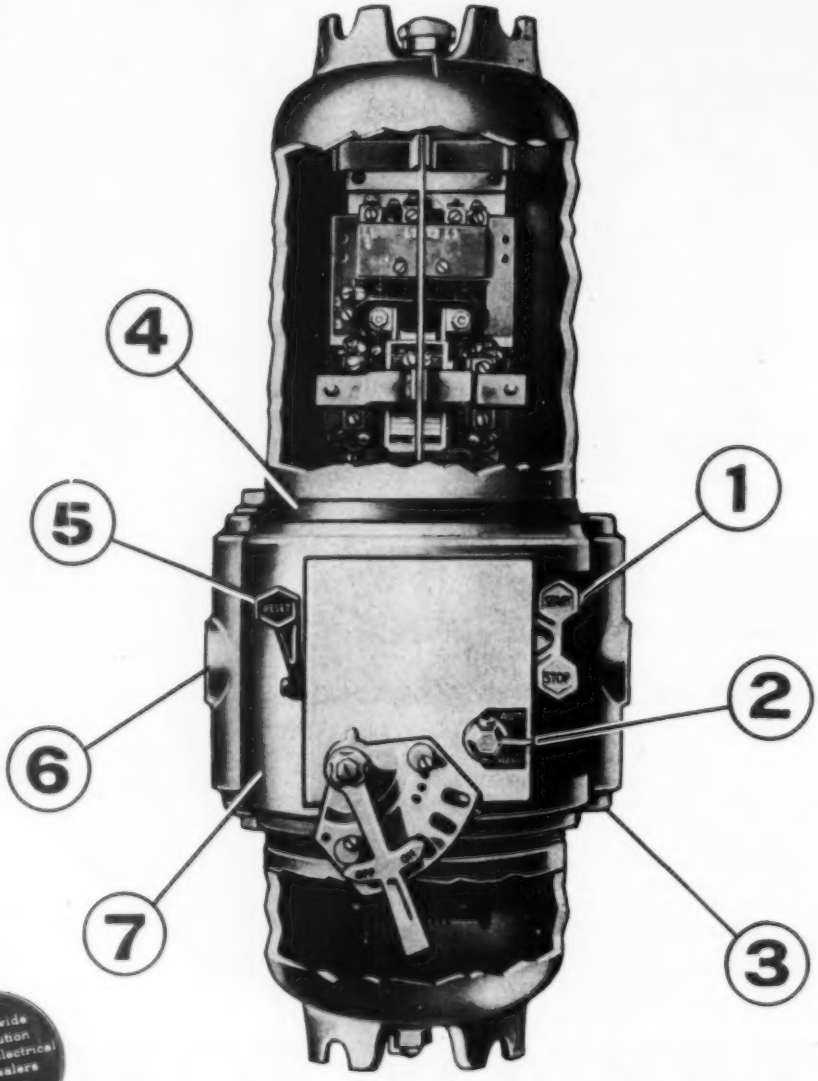
For up-to-the-minute facts see your Taylor Forge Distributor.

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS, General Offices and Works: P.O. Box 485, Chicago 90, Ill.
Offices in all principal cities. Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

7 important NEW features

... to the many basic advantages of



A Nationwide Distribution Through Electrical Wholesalers

CONDULETS · TRAFFIC SIGNALS

have been added
CROUSE-HINDS Type EPC
motor starter and circuit breaker CONDULET *

You get all of them on the Model M52

Model M52 EPC is the most flexible explosion-proof line starter and circuit breaker enclosure ever produced. The addition of 7 new features to the proven basic advantages of the EPC construction assures the greatest ease of installation and maintenance.

The exclusive basic advantages of the EPC Condulet have made it the world's leading enclosure for housing motor starters, circuit breakers and combinations for use in hazardous locations.

The basic advantages are:

EASY INSTALLATION . . . The use of a strong light-weight aluminum alloy and the unique three-section design makes it practical for an electrician and his helper to install the largest housing without the use of costly lifting equipment. The internal devices can be easily removed for pulling in the wires.

THREADED JOINT CONSTRUCTION . . . All joints are threaded. All operating shafts and bushings are thread-in-thread construction. This insures maximum safety, easy inspection and maintenance, and maximum corrosion protection.

FLEXIBILITY . . . A large number of different enclosures can be assembled from the wide variety of sizes of bodies and covers. They are not only used for circuit breakers and starters but have proven adaptable for many other types of electrical equipment. The body has numerous conduit hubs for flexibility of installation.

COST AND TIME SAVINGS . . . The outstanding advantages of the unique EPC Condulet over conventional explosion-proof enclosures all add up to lower installed cost and lower maintenance cost.

All of these advantages have been available for years.

Now Crouse-Hinds offers you 7 new improvements to underline the basic advantages of type EPC Condulets and to save you more dollars and more man-hours than ever before.

1. **Built-in Push button stations** available on line starters and combinations of line starters with circuit breakers — START — STOP, FOR — REV — STOP and HIGH — LOW — STOP stations for regular, reversing, or two-speed starters.
2. **Built-in selector switch** is available on line starters and combinations of line starters with circuit breakers. Normally supplied marked HAND — OFF — AUTO or JOG — RUN — OFF, three-position style. Two-position selector switch or combinations of selector switch with START — STOP station can be supplied.
3. **Back conduit entrance** can be supplied by drilling and tapping the boss in the center of the back . . . in addition to the four regular top and bottom hubs.
4. **Protective Neoprene gasket** is available for the upper cover joint. Where EPC Condulets are exposed to unusually severe weather or corrosive conditions, this gasket provides additional protection.
5. **A new RESET lever with threaded shaft,** rotating within a threaded bushing, provides easier and more positive operation of the reset mechanism.
6. **Horizontal through-feed conduit entrances** are provided by drilling and tapping bosses on the sides of the Condulet body.
7. **Greater ease in wiring** is provided by increased height in the center body section and by universal use of open framework mountings for circuit breakers and starters in the new model M52 EPC Condulets.

Model M52
Type EPC Explosion-Proof
Condulet in 7, 9, and 11-inch
body sizes

Send for YOUR copy of Bulletin 2634

*CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

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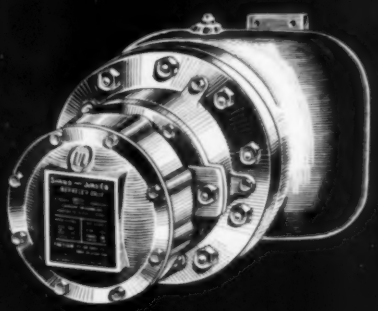
AIRPORT LIGHTING • FLOODLIGHTS

S&J LEVEL ALARMS

GUARDSMEN ALWAYS ON DUTY

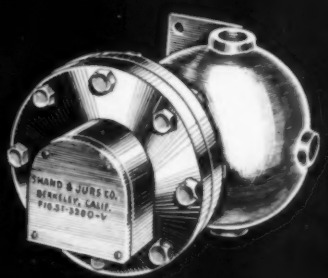
One of these Shand & Jurs Liquid Level Alarms is sure to solve any installation problem arising from location or operating conditions and stand watch over valuable petroleum products. Their use to actuate electrical or air operated devices with respect to predetermined liquid levels is almost unlimited. They will dependably signal or indicate the rise or fall of liquid past a predetermined point in any type of vessel. They are vigilant in warning operating personnel of unsafe conditions BEFORE a danger point is reached. Each alarm is actuated by a stainless steel, counterweighted float in a cast steel body.

S&J Magnetic-Electric Level Alarm. Designated Fig. ST-4440-UL, it employs no stuffing box, but uses permanent 6 pole magnets to actuate a mercury switch located in an S&J Explosion Proof Switch Box listed by Underwriters Laboratories. The alarm is fully automatic in operation, and the body is designed for working pressures up to 500 pounds.



S&J Electric Level Alarm. Fig. ST-5230A, this alarm is fully automatic in operation. It utilizes the S&J Explosion Proof Switch Box listed by Underwriters Laboratories in which the mercury switch is connected directly to the float shaft. The body is designed for 300 pound service.

S&J Air Valve Level Alarm, Fig. ST-5280V, this alarm operates on from 15 to 20 pounds air line pressure, and is reversible in operation by a simple change of the link connection to the float shaft. Body is designed for 300 pound service.



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ALLOY STEEL WELDING FITTINGS
LONGER LIFE FOR PIPING SYSTEMS
Extra thickness in critical areas
Greater wall thickness throughout
Key Company
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Since 1916
PIONEERS IN DEVELOPING AND MANUFACTURING PRODUCTS FOR HIGH TEMPERATURES AND PRESSURES

This New Bulletin Will Show You How KEY-KAST ALLOY WELDING FITTINGS Can Add Longer Life to Your Alloy Piping System—at Lower Cost. Send for Your Copy Today!

KEY-KAST ALLOY WELDING FITTINGS OFFER *ALL* THESE ADVANTAGES TO YOUR PIPING SYSTEM:

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- Extra thickness in critical areas—for greater allowance against corrosion and erosion.
- Lower unit cost.
- Meets A.S.M.E., A.S.T.M., and A.S.A. codes.
- Bosses provided on all fittings for tapped openings.
- Controlled quality . . . through rigid metallurgical control—produced, inspected and tested in one plant.

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Since 1916 . . . manufacturers and developers of products for high temperatures and pressure.

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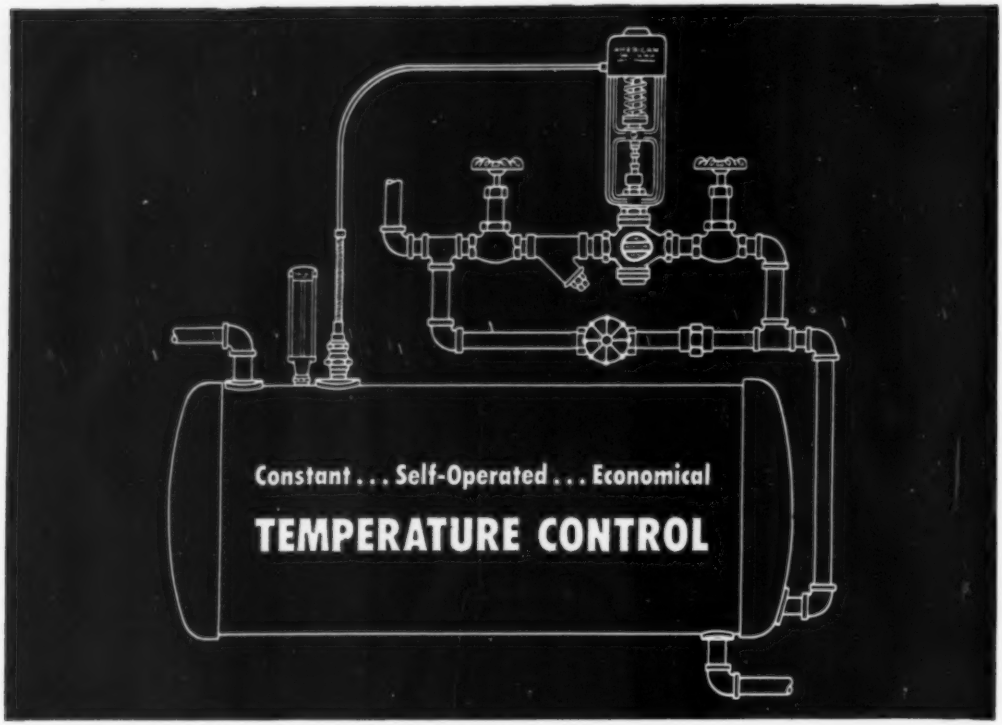
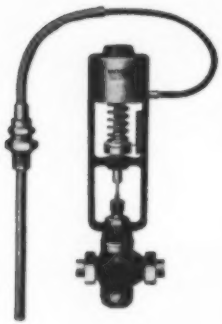


WITH AMERICAN TEMPERATURE REGULATORS



Positive temperature control of water, steam, oil and other media helps product quality, reduces costs.

American self-operated, precision temperature regulators *constantly* maintain prescribed temperature limits. They are made in sizes from ¼" through 4" with two types of valve action. The *reverse-acting* is for use in *cooling* processes; *direct acting* for application in *heating* processes.

Temperature is quickly set by turning a conveniently located adjusting nut. A scale, mounted on the frame, makes it easy to duplicate any established setting. To protect the regulator if the bulb is accidentally subjected to excessive temperature, a safety spring is provided between bellows and adjusting spring. Heavy armor safeguards the capillary tubing and seamless bellows – prevents damage and disturbance of the set temperature.

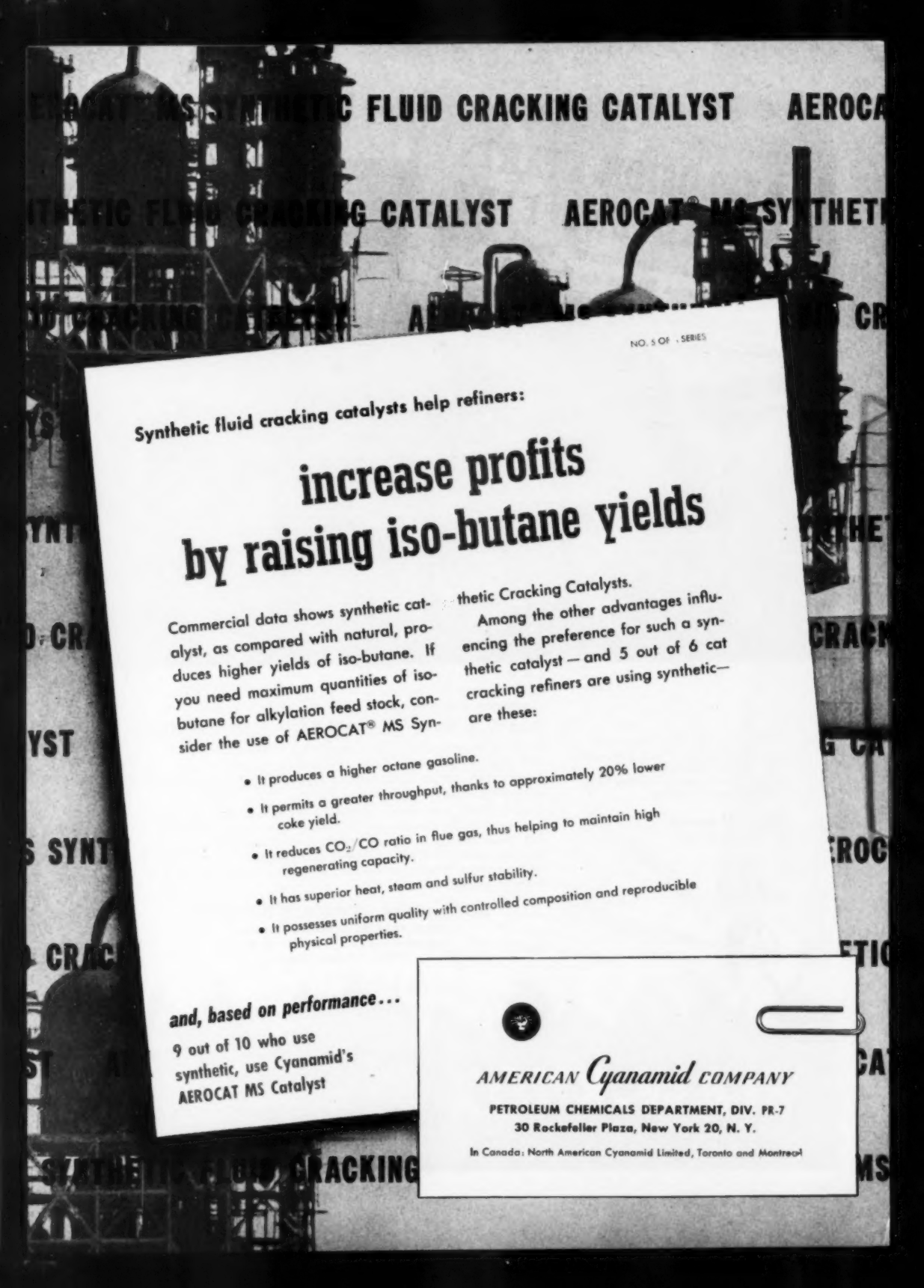
American Temperature Regulators are highly efficient, dependable, durable. They can effect important economies in your processing. Full details, including selection tables, contained in Bulletin 112.

Stocked and Sold by Leading Distributors

AMERICAN INDUSTRIAL INSTRUMENTS

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.



NO. 5 OF A SERIES

Synthetic fluid cracking catalysts help refiners:

increase profits by raising iso-butane yields

Commercial data shows synthetic catalyst, as compared with natural, produces higher yields of iso-butane. If you need maximum quantities of iso-butane for alkylation feed stock, consider the use of AEROCAT® MS Synthetic Cracking Catalysts.

Among the other advantages influencing the preference for such a synthetic catalyst — and 5 out of 6 cat cracking refiners are using synthetic — are these:

- It produces a higher octane gasoline.
- It permits a greater throughput, thanks to approximately 20% lower coke yield.
- It reduces CO_2/CO ratio in flue gas, thus helping to maintain high regenerating capacity.
- It has superior heat, steam and sulfur stability.
- It possesses uniform quality with controlled composition and reproducible physical properties.

and, based on performance...

9 out of 10 who use synthetic, use Cyanamid's AEROCAT MS Catalyst

AMERICAN Cyanamid COMPANY

PETROLEUM CHEMICALS DEPARTMENT, DIV. PR-7
30 Rockefeller Plaza, New York 20, N. Y.

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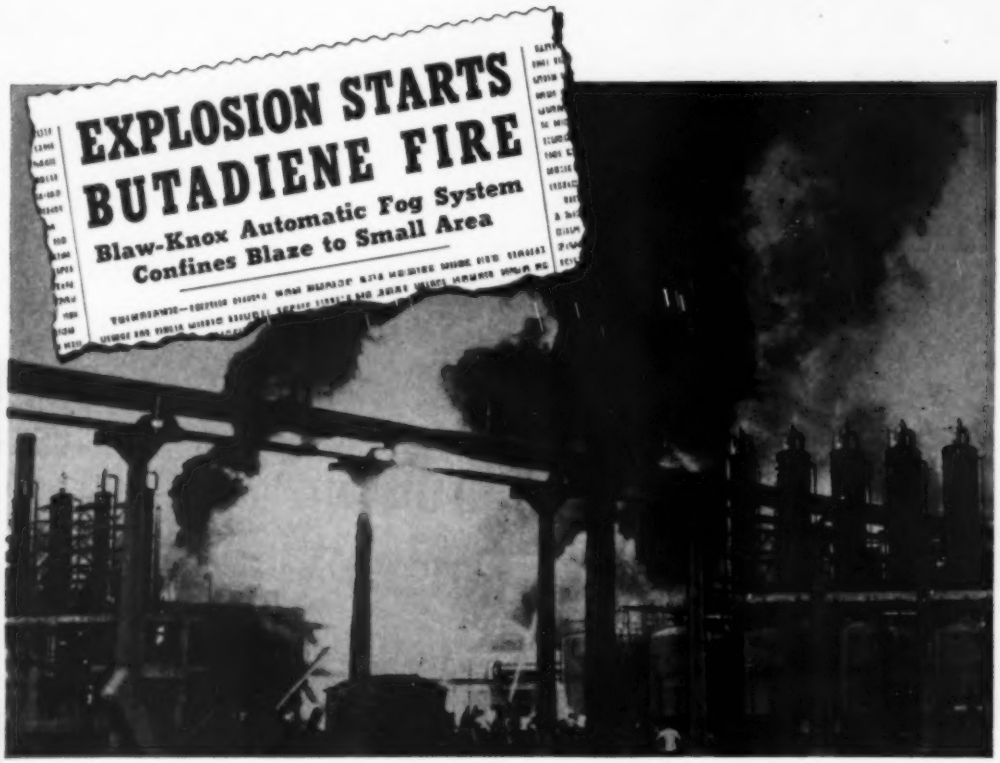

A serious fire, yes, but no "total loss"—thanks to the protection of adjacent equipment by smothering blankets of water from a

BLAW-KNOX AUTOMATIC FOG SYSTEM

Actuated by rate-of-rise thermostats, this system sounds an alarm and instantly throws a dense, quenching fog of water on the danger spot—either extinguishing or controlling the blaze while protecting adjacent equipment.

A Blaw-Knox System engineered for the fire hazards existing in or around your plant is a most effective weapon against fire's toll. Your insurance savings as they accrue applied to its cost—provide you with the utmost in fire protection plus a good financial investment . . . Glad to consult with you and submit an estimate without obligation.

BLAW-KNOX SPRINKLER DIVISION
of BLAW-KNOX CONSTRUCTION COMPANY
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Deluge Systems, Wet Pipe Systems, Dry Pipe Systems, Water Spray and Fog Systems, Rate-of-Rise Sprinkler Systems, and Foam and Carbon Dioxide Extinguisher Systems.

"LITTLE JOEY SPRINKLER"
Always on the Job

BLAW-KNOX AUTOMATIC FIRE PROTECTION SYSTEMS

TERRY

The rotor of a Terry Solid-wheel Turbine is a single forging of special composition steel. It is first rough turned in two operations, as illustrated, and then two cuts are taken to mill the semi-circular buckets from the solid metal. The wheel at the top has been finished, ready for mounting on the shaft. *The result is a single-piece wheel with no parts to loosen or work out.*

As the only function of the blades is to form a series of pockets, wear of the blades is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.

It is impossible for the blades to foul. They have large clearances, and are further protected by the projecting rims at the sides of the wheel. As the side clearances are also very large, end play can do no harm.

The Terry Solid-wheel Turbine is an extremely reliable piece of equipment. Why not write for complete details today?

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

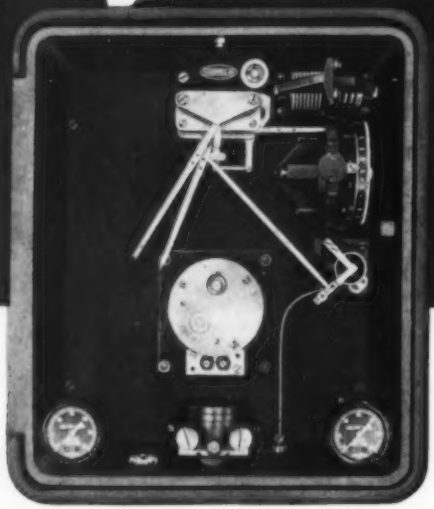
TT-1180

Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

So You Want to Buy a

Of course you'll compare the various models offered. You will note that:—



All have the same basic components . . .
primary element, proportioning mechanism, pilot.

All operate on same basic principle . . .
measure changes in controlled variable, apply corrective measures by regulating an output pressure.

BUT HERE THE DIFFERENCES BEGIN

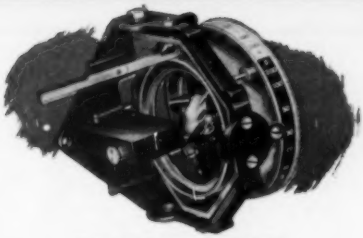
differences that are important to the instrument man and operator: differences in design and arrangement which result in great variations in simplicity, versatility, reliability and ease of adjustment and servicing.

For example, note how refinements in design make the Masoneilan 60000 Series Controller outstandingly different from most other types —

A HIGH Cq PRODUCT

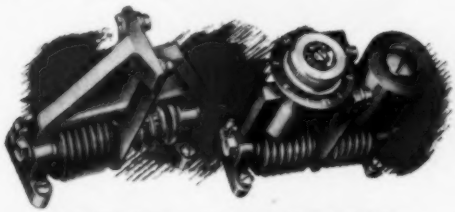
SEE THEM AT THE INSTRUMENT SHOW . . . BOOTHS 435-439

Pneumatic Controller!



THE GIMBAL UNIT...

the heart of the mechanism which regulates the flow of power from the controller — selects *four* combinations of primary and feedback motion to provide proportional, differential-gap and on-off control with direct or reverse action — makes this controller more versatile than any other. The proportional band wheel, by one simple adjustment, selects the *type* of control, the *action* and the proportional band or differential-gap *setting*.

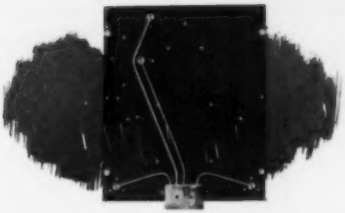


INDIVIDUAL, INTERCHANGEABLE SUBASSEMBLIES...

without linkage complexities, provide for (a) addition of standard subassemblies *easily*, to obtain pneumatic set, time schedule, differential control; (b) *easy* interchange of standard proportional and proportional-rest units; (c) ease of servicing because each sub-assembly is *individually* accessible.

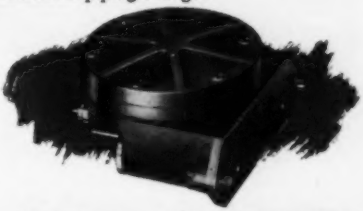
EASE OF ADJUSTMENT...

provided by accessibility without removing chart; by large knobs and large diameter proportional band wheel; by easily read graduated scales.



MANIFOLDING OF ALL AIR PASSAGES

with plug-in connections (a) aids accessibility, (b) eliminates pressure fittings, (c) permits interchange of components or addition of manual control subpanel *without piping changes.*



BALANCED, AMPLIFYING PILOT...

insures maximum capacity and stability in flow of output pressure. Includes latest refinements such as plunger-cleaned sapphire restriction, filters in outlet and inlet ports, frictionless floating valve action. Easily removed for servicing.

MULTIPLE PEN MOVEMENT...

provides common axis of rotation for pens and index, ball pivots, index setting by manual or automatic (e.g., Pneumatic Set, Time Schedule, etc.) adjustment.

With accurate, stable performance plus unmatched simplicity, versatility and reliability — the Masoneilan 60000 Series Controller is truly the Instrument Man's Instrument for pressure, temperature, liquid level or flow control.

MASON-NEILAN REGULATOR CO.

1182 ADAMS STREET, BOSTON 24, MASS., U. S. A.

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EVIDENCE OF SUPERIORITY IN *Corrosive Service*

BEFORE *Midwest 4" extra heavy weight, carbon steel tee showing original wall thickness of tee at right before it was accidentally subjected to corrosive conditions.*

AFTER *When straight pipe in line had failed from corrosion, this Midwest tee was removed. Note amount and uniformity of wall thickness remaining.*

A valve leaked or somebody opened it by mistake . . . so the Midwest Tee shown above was subjected to dilute hydrofluoric acid in addition to its normal service in a 300° F. hydrocarbon line on an alkylation unit.

The highly corrosive acid caused failure of the straight pipe . . . so the entire line had to be replaced. When cut out of the line, the Midwest Tee was found to have a considerable (and uniform) wall thickness. There was no selective corrosion and the weld held up even better than the parent metal.

This was not special alloy made to resist corrosion, but regular Grade "A" carbon steel . . . the same as the new tee shown left above. We do not, of course, recommend carbon steel for corrosive conditions, but, in emergency, it gives good account of itself.

The exclusive Midwest manufacturing process produces fittings of superior metallurgical properties. The metal is worked in compression . . . it is not stretched or extruded, and distribution is uniform. After forming and welding, the fitting is stress-relieved. For further information, write us for a copy of Catalog 48.

MIDWEST PIPING & SUPPLY CO., INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo.

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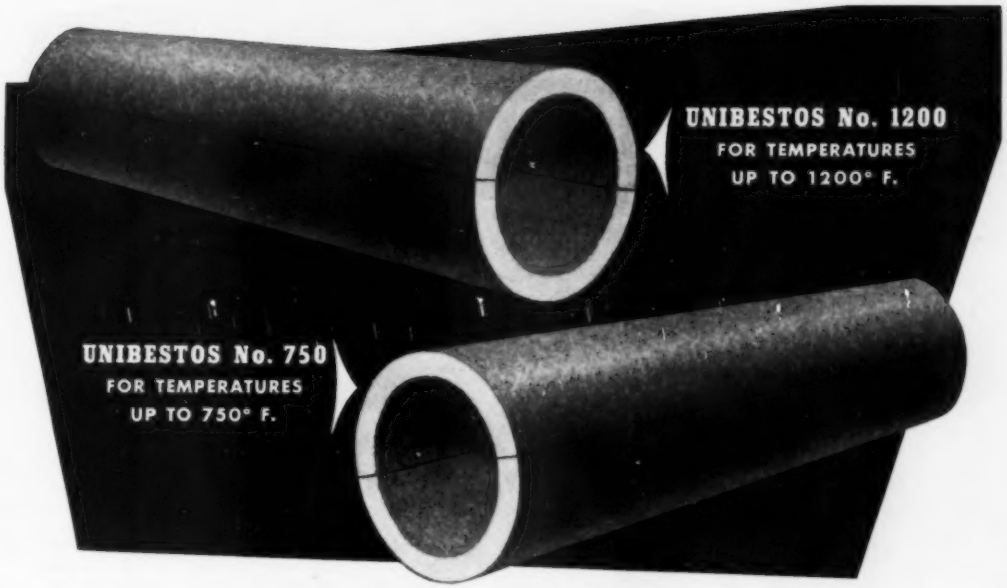
MIDWEST WELDING FITTINGS

IMPROVE DESIGN AND REDUCE COSTS



These famous UNIBESTOS twins cut heat loss and surface temperature

HIGH EFFICIENCY IS UNIMPAIRED BY REUSE OR CONTINUOUS SERVICE

When you insulate with Unibestos you can be sure of *prolonged* effectiveness, for this durable, high quality insulation resists all service hazards. It's unaffected by moisture, steam, fumes . . . withstands impact and vibration . . . won't shatter, crumble, powder, or dust to contaminate the atmosphere under normal service conditions.

Unibestos is easy to cut and fit . . . brings you the added economy of *single-layer* application . . . may be removed and reused repeatedly without damage or loss of efficiency. Adjacent sections can be stapled together to prevent separation due to expansion.

Phone your Unarco Distributor for *money-saving* Unibestos in cylinders, half-rounds, or blocks.

UNARCO

UNION ASBESTOS & RUBBER COMPANY

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All SHELL AND TUBE ...HEAT EXCHANGERS by Vogt

ABOVE: View of new construction at Louisville Refining Company.

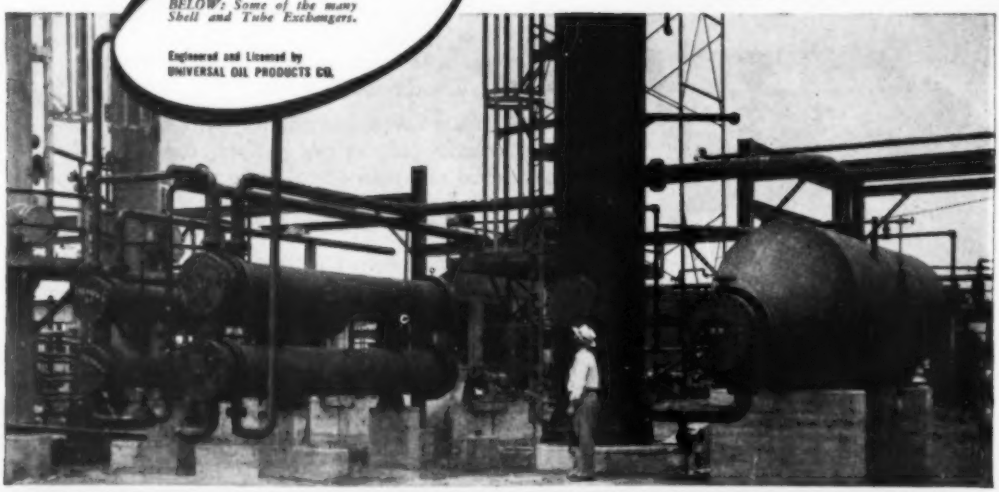
BELOW: Some of the many Shell and Tube Exchangers.

Engineered and Licensed by UNIVERSAL OIL PRODUCTS CO.

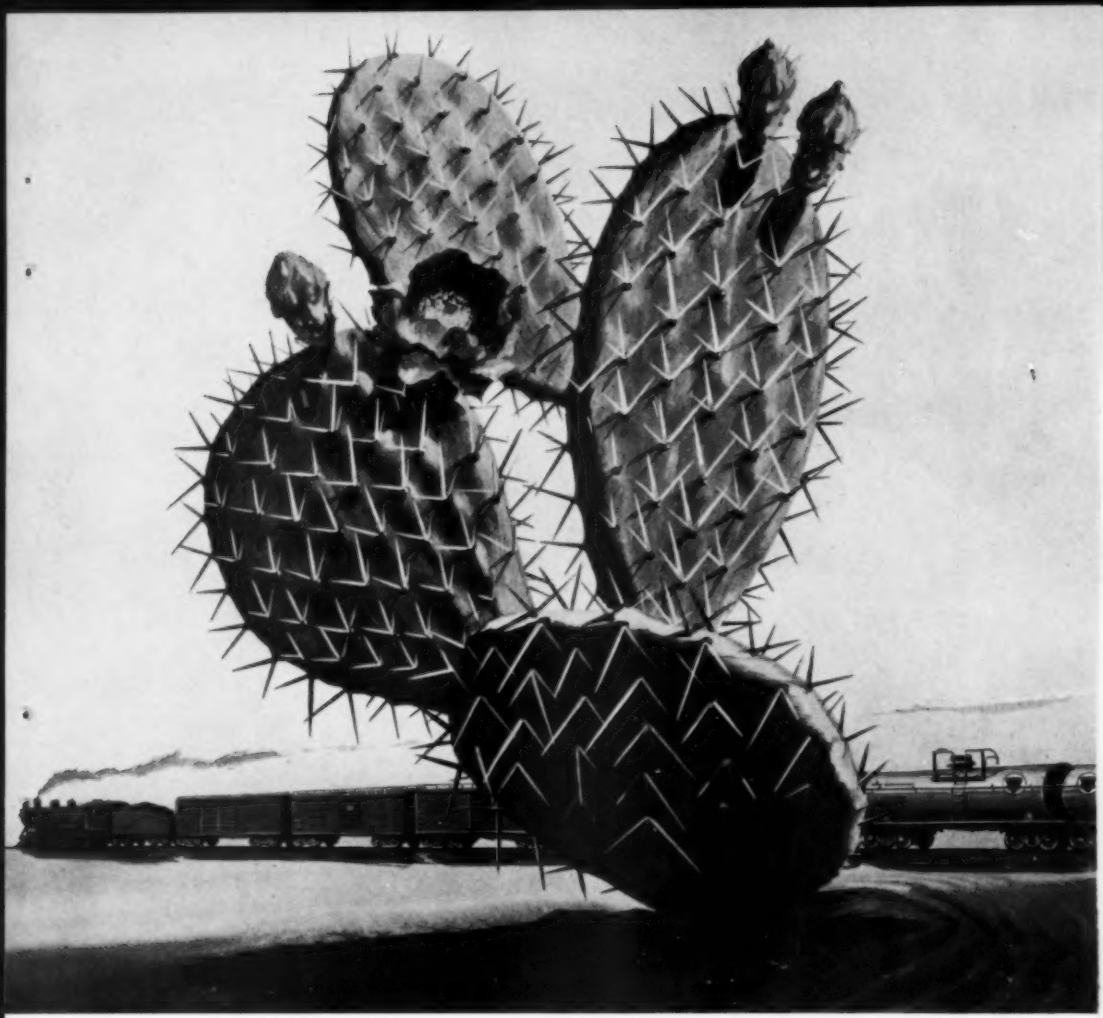
At LOUISVILLE REFINING CO.'S New CATALYTIC CRACKING PLANT

Premium gasoline production has been boosted 20% from the same amount of oil charged since the Louisville Refining Company's new Catalytic Cracking Plant went on stream.
The new plant uses Vogt Shell and Tube Heat Exchangers exclusively and they make a significant contribution to the efficient and economic operations of this progressively modern refinery.
Vogt Shell and Tube Heat Exchangers are available in many different types, with fixed or removable tube bundles, to meet the special problem and specific operating conditions of each installation. They are constructed from carbon and special steels to meet every temperature, pressure, or vacuum service requirement.

WRITE FOR BULLETIN HE-6



HENRY VOGT MACHINE CO. Louisville 10, Ky. • BRANCH OFFICES: NEW YORK, PHILADELPHIA, CHICAGO, CLEVELAND, ST. LOUIS, DALLAS, CHARLESTON, W. VA.



We're shipping from Texas now!

Cars of "Ethyl" antiknock compound are now starting to roll out of our new Texas plant.

In case you haven't heard the full story of this new plant . . . we have just completed a new antiknock compound manufacturing center on the Houston ship channel in Texas. It's the most modern plant of its kind in the world . . . the only one west of the Mississippi.

(*continued on next page*)

ETHYL
ETHYL CORPORATION

We're shipping from Texas now!

(continued from preceding page)

This new plant greatly increases Ethyl's manufacturing capacity, and our ability to serve the nation's petroleum industry. It's a completely "integrated" plant. All the complex chemicals needed to produce tetraethyllead are made here from raw materials such as salt, pig lead, petroleum gases and electricity. The location of the new plant was picked to be near these basic raw materials.

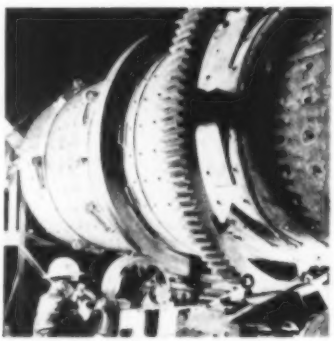
Today, we can dispatch Ethyl fluid to you from any one of *four* shipping points, Baton Rouge, Louisiana; Houston, Texas; Edge Moor, Delaware; and Wilmington, California. Refiners are now, more than ever before, assured of a dependable supply of "Ethyl" antiknock compound delivered where and when they want it.

ETHYL CORPORATION

NEW YORK 17, NEW YORK

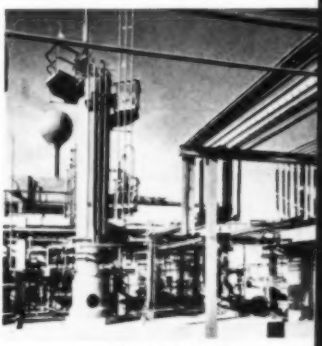
Ethyl service is backed by 29 years of antiknock experience

HERE ARE A FEW OF THE MANUFACTURING UNITS IN OUR NEW TEXAS PLANT



A SALT DRYER IN THE SODIUM BUILDING

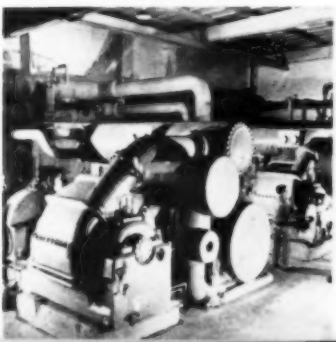
HIGH-VOLTAGE LINE FOR SODIUM CELLS



THIS IS THE ETHYL DICHLORIDE PLANT

THE ETHYL CHLORIDE UNIT IS A PLANT IN ITSELF

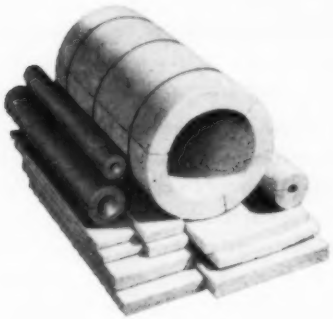
REFRIGERATION COMPRESSORS IN THE ETHYL CHLORIDE UNIT



TETRAETHYLLEAD MANUFACTURING BUILDING

NEW GASOLINE PROCESSING PLANT, Ringwood, Oklahoma is insulated throughout with Kaylo Heat Insulation. Co-owners: Warren Petroleum Co. and Oklahoma Natural Gas Co. General Contractor: Gasoline Plant Construction Co., Houston, Texas.

Leading Industries Are Switching to KAYLO HEAT INSULATION



Kaylo Heat Insulation offers an outstanding combination of advantages—in *both* performance and application.

With its *effective* temperature range—up to 1200° F . . . plus an unmatched selection of sizes and shapes and Simplified Dimensional Standards that allow nesting, Kaylo Heat Insulation reduces the number of pieces required per job.

Kaylo Heat Insulation is hydrous calcium silicate, *not glass.* It is insoluble in water, incombustible and exceptionally lightweight—yet strong. Breakage is almost negligible. Easily cut and fitted, it is installed with standard tools.

You'll find that your jobs can be done better with Kaylo Heat Insulation. Get *all* the facts about its advantages.

WRITE FOR FREE BOOK—"Kaylo Heat Insulation." Address: Dept. N-242, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

KAYLO® **. . . first in calcium silicate**

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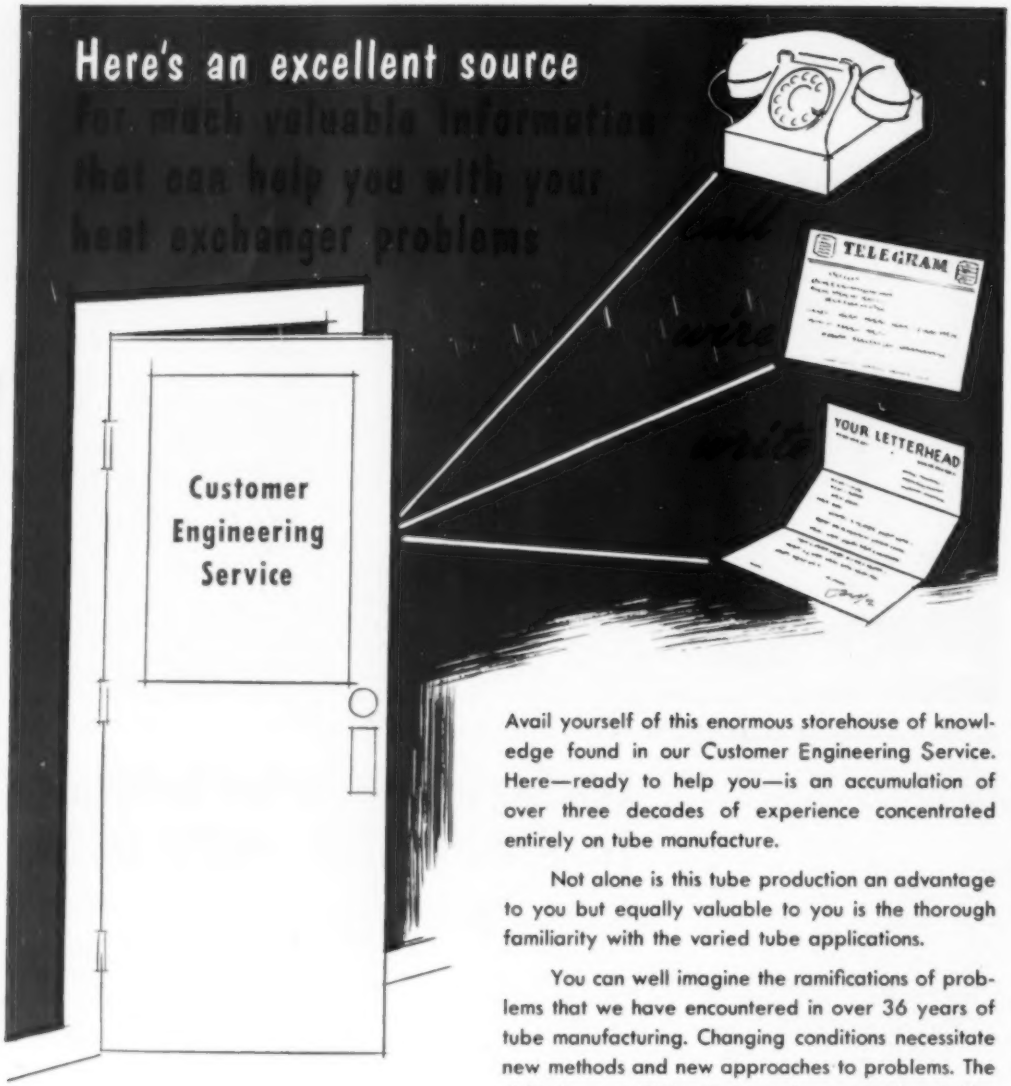
Here's an excellent source

For much valuable information that can help you with your heat exchanger problems



Avail yourself of this enormous storehouse of knowledge found in our Customer Engineering Service. Here—ready to help you—is an accumulation of over three decades of experience concentrated entirely on tube manufacture.

Not alone is this tube production an advantage to you but equally valuable to you is the thorough familiarity with the varied tube applications.

You can well imagine the ramifications of problems that we have encountered in over 36 years of tube manufacturing. Changing conditions necessitate new methods and new approaches to problems. The sights here at Wolverine are always set ahead. Our technicians are always ready for you with the best answers that will improve your efficiency in operation.

Let us relieve you of some of the problems dealing with heat exchangers, condensers, etc.

WOLVERINE TUBE DIVISION
Calumet & Hecla Consolidated Copper Company
INCORPORATED
Manufacturers of seamless, nonferrous tubing
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CHECK THESE "800" HIGHLIGHTS YOURSELF . . .

- **EXCEPTIONAL VERSATILITY** . . . from welding and cutting to descaling and flame cleaning, hardening, and hardfacing.
- **WIDE TIP RANGE** . . . long flame or bulbous up to size 10. In separable swaged tips — up to size 13.
- **LOWER OPERATOR FATIGUE** . . . 10 inches long, 21 ounce weight; planned balance minimizes operator fatigue.
- **FOR METAL CUTTING, TOO** . . . quickly converted for cutting either thin sheets or heavy plate up to 5-6" thick.

Ask for Catalog 2, Hand Torches for Welding and Cutting.

The Airco No. 800 Torch — with a wider welding range than any other torch on the market — is ready for any job from fine sheet work to heavy sections. A wide selection of tips permits unusual weld-and-cut versatility . . . while rugged construction makes it a natural for "rough and tumble" shop and field work.

AND . . . the Airco 8400 series two-stage regulator is your guarantee of constant gas pressure. One pressure setting needs no further attention. Saves time, gas, with trouble-free operation — gives better flame performance in welding and cutting. Ask for Catalog 5, Regulators.

SUPPLIES, TOO . . . Airco maintains a full line to complete the team for all around welding, cutting and hardfacing. Write for further information on welding rods (Catalog 12) . . . electrodes (Catalog 10) . . . as well as hardfacing alloys (Catalog 11) . . . and accessories, (Catalog 13).

AN AIR REDUCTION PRODUCT

AT THE FRONTIERS OF PROGRESS YOU'LL FIND

AIRCO®

AIR REDUCTION MAGNOLIA COMPANY

A Division of Air Reduction Company, Incorporated

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Southwestern Headquarters for Oxygen, Acetylene and Other Gases . . . Carbide . . . Gas Welding and Cutting Machines, Apparatus and Supplies . . . Arc Welders, Electrodes and Accessories

Straight-Line Flow... the economical path from fresh feed to product...

Orthoflow, the new streamlined Fluid catalytic cracker by Kellogg, brings new flexibility and economy to petroleum processing.

In the **Orthoflow** single-vessel units, transmission lines for both catalyst-oil mixture and spent catalyst are fewer, shorter and straight . . . slide-valves and expansion joints are eliminated . . . the catalyst transmission system completely streamlined. Erosion is minimized, maintenance brought to a new low and flexibility of operation retained.

Orthoflow can handle practically any feedstock, from kerosene to the heaviest gas oils. High-boiling stocks are charged as liquids and vaporized by regenerated catalyst with minimum use of preheat facilities.

Orthoflow also permits wide latitude in conversion, recycle, and feed rates.

In this simplified Fluid cracker design, Kellogg engineers have achieved significant savings in original investment. With both reactor and regenerator incorporated into a single vessel, **Orthoflow** saves steelwork, saves on foundations, saves piping . . . and saves thousands of manhours too.

PROGRESS REPORT
ORTHOFLOW CATALYTIC CRACKERS

UNITS OPERATING:

In Western Canada—	2,500 BPD Unit
In Mid-Continent U. S.—	8,300 BPD Unit
In Eastern Canada—	8,300 BPD Unit

UNITS UNDER CONSTRUCTION:

On the Atlantic Seaboard—	28,000 BPD Unit
In Mid-Western U. S.—	17,000 BPD Unit
On the Gulf Coast—	26,000 BPD Unit

Kellogg Orthoflow

COMPARATIVE ELEVATIONS · FLUID CATALYTIC CRACKERS · EQUAL CAPACITY

SIMPLICITY, the outstanding characteristic of **Orthoflow** and the ultimate in any field of design, is the logical outcome of Kellogg experience in Fluid catalytic cracking . . . which dates from the inception of the process and includes the engineering of 70 percent of the world's total fluid capacity. Details of this important new development in Fluid cracking are presented in Kelloggram No. 1—1952 Series "From Baton Rouge to Orthoflow". If you haven't received it, we'll be glad to send a copy on request.

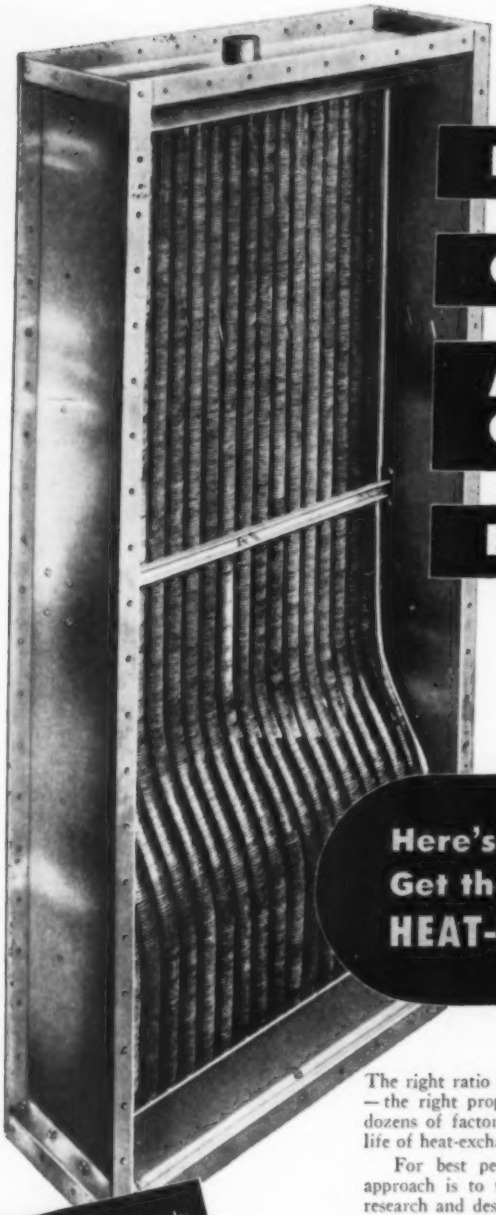
THE M. W. KELLOGG COMPANY

(A Subsidiary of Pullman Incorporated)

NEW YORK JERSEY CITY LOS ANGELES TULSA HOUSTON TORONTO LONDON PARIS

KELLOGG

. . . . . for fifty one years an integral part of petroleum refining progress!



Heating?

Cooling?

Air Conditioning?

Process?

Here's How to Get the RIGHT Answer to your HEAT-EXCHANGE PROBLEMS

The right ratio of surfaces – the right materials – the right velocities – the right proportion between coil area and depth . . . there are dozens of factors that affect the efficiency, maintenance and service life of heat-exchange coils.

For best performance in your own application, the practical approach is to take full advantage of the unequalled engineering, research and design skill – the unequalled manufacturing and testing facilities – which Aerofin offers you.

To get the *right* answer – ask the Aerofin man.

Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

AEROFIN CORPORATION

410 South Geddes St. SYRACUSE 1, N. Y.

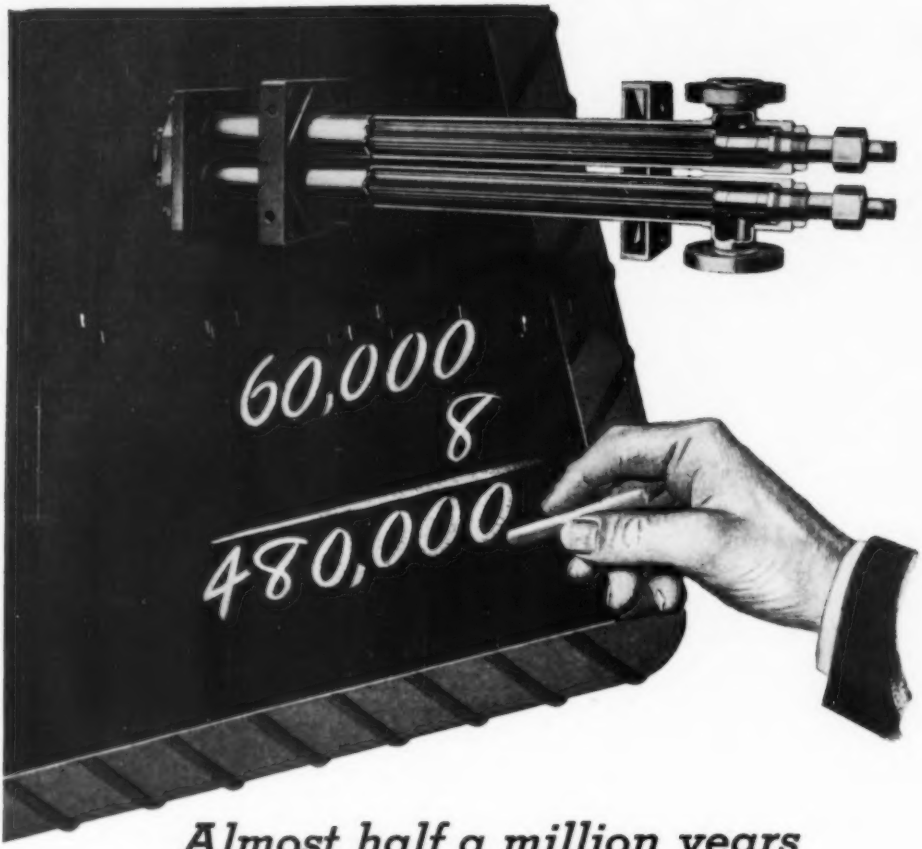
Squirrel cage motors, slip ring motors, synchronous motors, repulsion induction motors, capacitor motors, direct current motors . . . open, enclosed, splash-proof, fan-cooled, explosion-proof . . . horizontal or vertical . . . for all phases, voltages and frequencies . . . in single speed, multi-speed and variable speed types . . . with or without flanges or other special features . . . with 5 types of gear reduction up to 432 to 1 ratio . . . with electric brakes . . . with mechanical variable speed units . . . and for every type of mounting . . . Master has them all and so can be completely impartial in helping you select the one best motor drive for YOU

And all of these, the electric motors . . . the electric brakes . . . the gear reduction units . . . the variable speed drives . . . all are designed so they can be easily combined together to give you the RIGHT horsepower, the RIGHT shaft speed, the RIGHT mounting features in one compact power drive.

That's the horsesense way to use horsepower whether you want 1/8 horsepower or 200 horsepower.

THE MASTER ELECTRIC COMPANY
DAYTON 1, OHIO

1/8 TO 200
HORSEPOWER



Almost half a million years of heat exchanger service!

Multiply the number of installed G-R Twin G-Fin Sections by a conservative estimate for average length of service and that's the figure you get . . . almost half a million total years of service!

Some Twin G-Fin Sections have been in continuous use for more than 20 years. And no matter what the length of service or type of heat transfer duty, here is the uniform report of users . . . effective, durable, troublefree, economical.

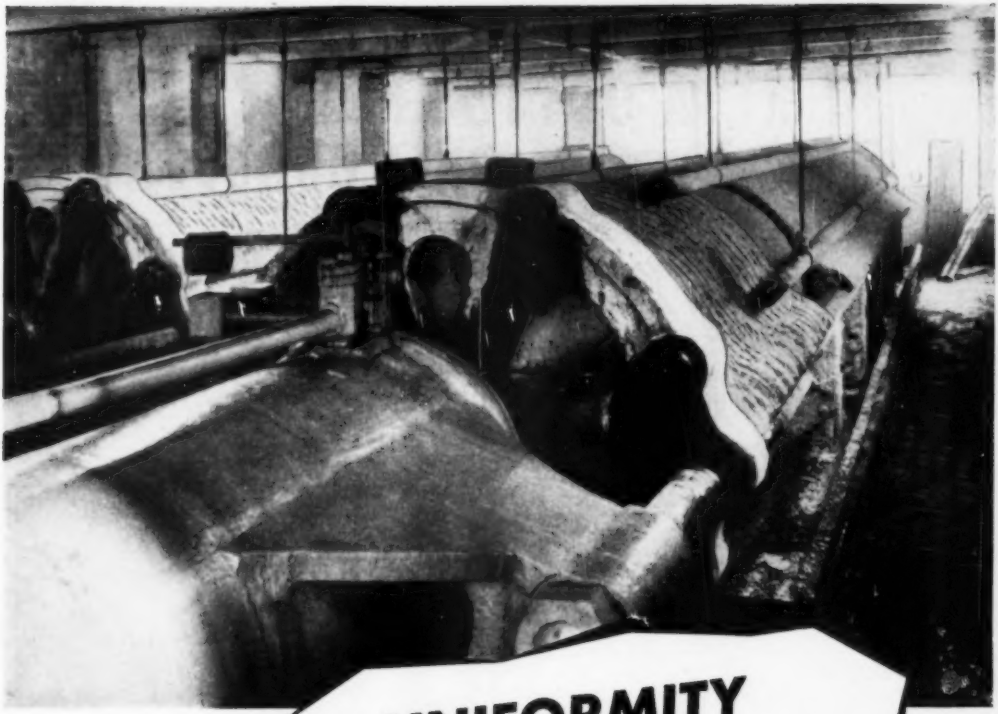
Twin G-Fin Sections can be used for a greater variety of services than any other design of heat transfer apparatus . . . that's one of their many advantages. Their installations include almost every type of heating, cooling, condensing, and heat exchange, and with many different liquids, gases and vapors.

Investigate the possibilities in your own plant for these time-proven standard interchangeable heat exchangers with the famous G-Fin elements. Write for bulletin, and ask about their applications to your heat transfer needs.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

G-R HEAT TRANSFER APPARATUS ***Twin G-Fin Section***

GR 280



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Makes the Big Difference In FILTER Fabrics

Gives You Greater Fabric Uniformity

Determining yarn tensile strength with 300-lb. vertical test. One of a series of comprehensive laboratory controls throughout production to assure uniformity in all Mt. Vernon-Woodberry products.

Mt. Vernon-Woodberry Mills

TURNER HALSEY COMPANY
Selling Agents
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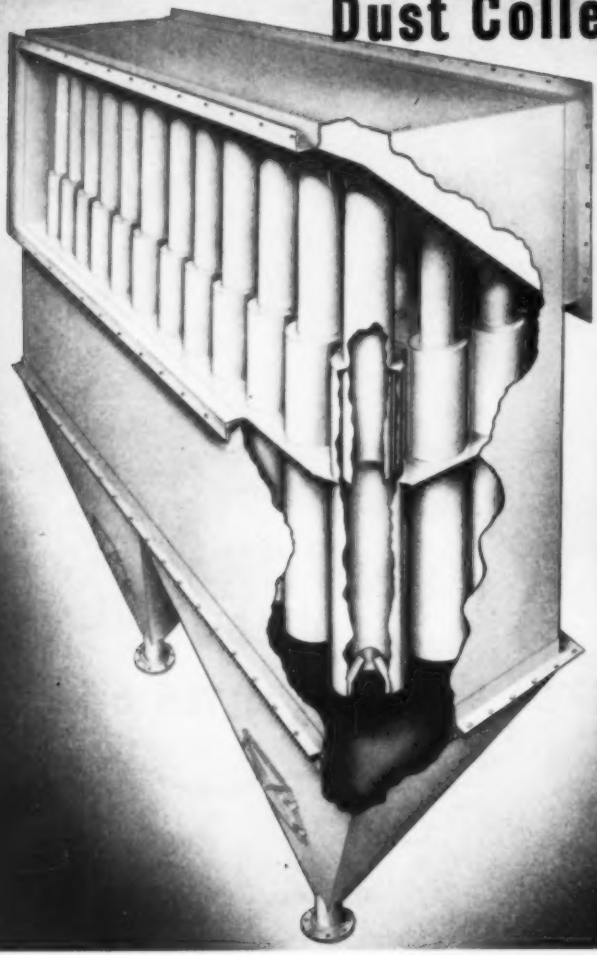
For Ultimate Efficiency

Type MTSA 9CY18S Multi Cyclone Dust Collectors



"Whirlex" multi-tube cyclone dust and fly-ash collectors are efficient, compact and versatile. They are highly efficient in collecting dust in the lower micron ranges with almost total removal of solids above 325 mesh. The compact cyclone tube units may be grouped in a wide variety of arrangements to permit installations in crowded locations. Gas inlets and outlets may be located in side or top of collectors and angle types are also available. The Fly Ash Arrestor Corporation manufactures a complete line of low draft loss collectors for installation in stacks and ducts. Highly efficient induced draft fans are made to order together with constant ratio dampers, fly ash injection systems, and overfire air systems. Stacks and necessary connecting duct work are made of heavy welded steel. Proper vaning is provided to reduce turbulance in ductwork. Write for detailed literature and address of your nearest representative.

THE FLY ASH ARRESTOR CORPORATION

BIRMINGHAM ALABAMA

261 North First Street

Telephone 54-6676

Increase
FILTER CAPACITY

with

PALMER

FILTER BED AGITATORS

and

ANTHRAFILT

FILTER MEDIA

LOCAL STOCK AVAILABLE
FOR IMMEDIATE SHIPMENT

You'll get increased filter capacity without expensive additions to your plant when you install PALMER FILTER BED AGITATORS . . . when you change to ANTHRAFILT FILTER MEDIA. Repeated tests prove that you get longer runs at higher rates with less wash water consumption.

We suggest you try AGITATORS and ANTHRAFILT in one of your filters; you will eventually ask us to equip your entire plant.

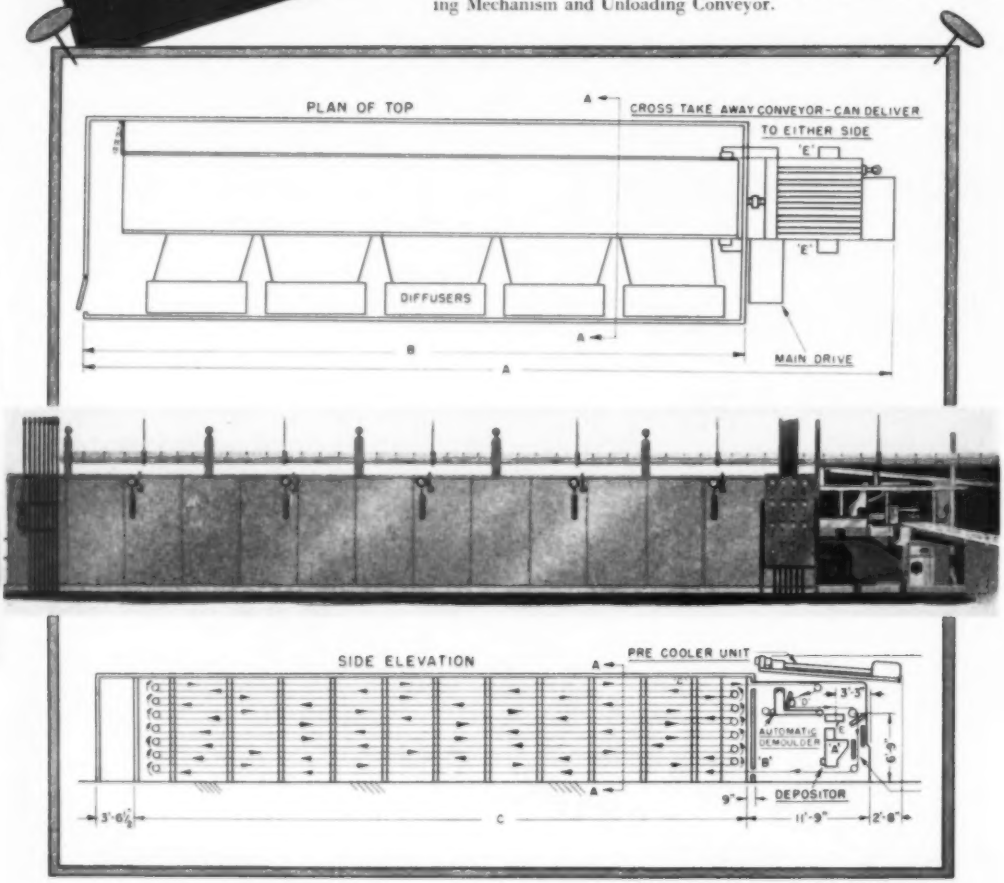
THE GREER AUTOMATIC WAX MOULDING MACHINE

THE GREER CONTINUOUS WAX MOULDING MACHINE is a completely automatic machine for processing liquid wax into finished slabs. This production-proven equipment is an adaptation of machines which have been manufactured for many years by the Greer company for chocolate manufacturers.

Basically, the Wax Moulding Machine has been designed to perform, automatically, a series of essential operations. First, it receives liquid wax from storage tanks and precools it to controlled depositing temperature. It then deposits the wax in moulds and cools the resulting slabs to a solid state. Finally, it de-moulds the slabs (10½ lbs. each). Weights other than 10½ lbs. can readily be obtained.

The size of the machine to produce 15,000 lbs. per hour is only 90 feet long, 20 feet wide and 11 feet high. Supervisory help only is required.

The machine consists of five basic units: A Pre-cooling Unit, A 6-Cylinder Volumetric Depositor, A standard Greer Multi-Tier Conveyor, A Refrigeration Bunker Box, and An Automatic Demoulding Mechanism and Unloading Conveyor.



J. W. GREER COMPANY

Write today for Bulletin 51-2.

119 WINDSOR STREET, CAMBRIDGE 39, MASSACHUSETTS

Sales Engineering Offices: New York, N. Y., Chicago, Ill., San Francisco, Calif.

GREER

It took two railroad cars to provide "passenger accommodations" for this depropanizer tower—as Sun Ship workers readied it for shipment.

tough bronco—
PETROLEUM!

Ever see a bronco at the first touch of the saddle? Ever see a gusher well come in? The resemblance doesn't end with the furious first burst of action, even though the saddled pony stands quiet . . . and the stream of black gold pours placidly into the refinery—until man renews his taming process.

Breaking a fractious horse . . . cracking petroleum . . . makes them both useful. And both tasks throw the full test of pressure on the men who tackle the job . . . and on the equipment they use.

Tanks and towers . . . in fact all refinery and chemical equipment built at Sun Ship has been meeting the toughest tests of pressure through years of service. That's to be expected. The men of Sun Ship who build it have shown their ability to meet and master the production pressure of time . . . and the engineering and shipping problems that go with the task of constructing and delivering the gigantic equipment that helps build a greater and stronger America.

Sun

SHIPBUILDING & DRY DOCK COMPANY

SINCE 1916

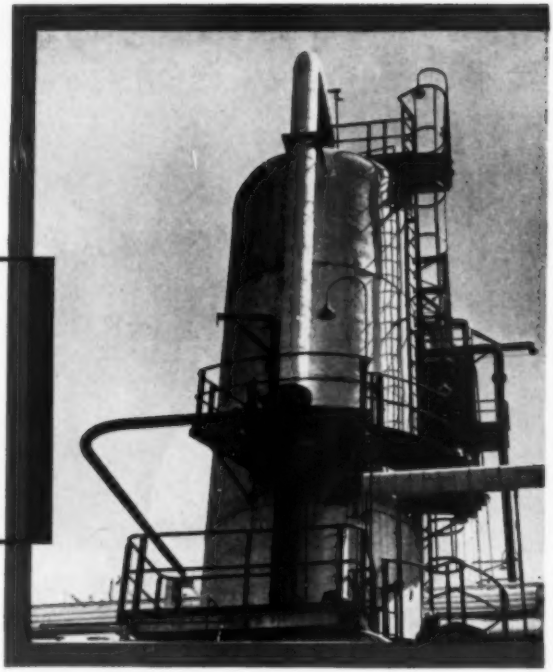
ON THE DELAWARE • CHESTER, PA.

25 BROADWAY • NEW YORK CITY

TRET·O·LITE

Chemical Desalting

COSTS LESS



To install

To operate

To maintain

To service

Tretolite Desalting costs less to install because a Tretolite plant utilizes conventional refinery equipment. Many refiners have assembled their Tretolite desalters from existing equipment, thereby holding installation costs at minimum.

A recent survey of a group of Tretolite desalting plants processing over a million barrels per day showed that the average cost per barrel of desalting was 2.5 mills. Compare this cost with the cost of any other desalting process.

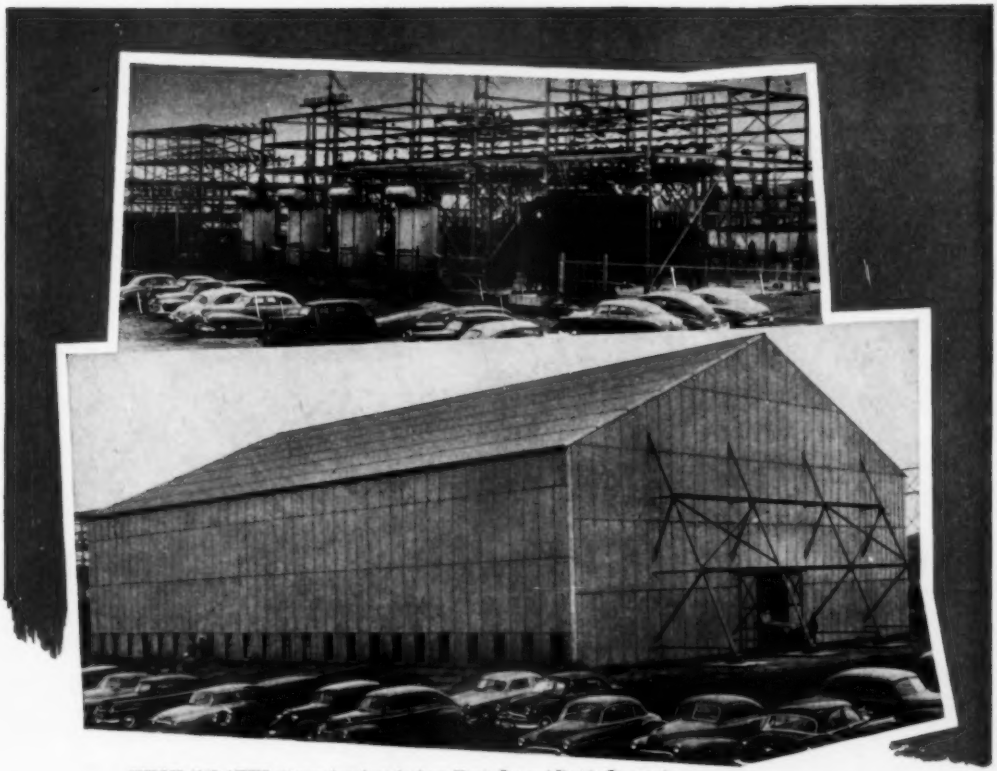
The simplicity of Tretolite Desalting eliminates major shut-downs caused by equipment failures. The absence of elaborate mechanical and electrical components insures smooth, trouble-free operations.

Tretolite Desalting plants cost less to service because, as noted above, maintenance is simple. Beyond routine servicing, Tretolite desalting engineers are on call for consultation and assistance on any problem relative to more efficient desalting. If you want the best in desalting, for the lowest investment, call or write to the

TRETOLITE COMPANY
SAINT LOUIS 19, MISSOURI · LOS ANGELES 22, CALIF.

DESALTING • CORROSION INHIBITING
DEHYDRATING • SCALE PREVENTING
WATER DE-OILING

TD 58-3



"BEFORE AND AFTER" pictures show how the Iowa-Illinois Gas and Electric Company's sub-station at Bettendorf, Iowa, was protected by an "umbrella type" cover of "Century" Asbestos-Cement Corrugated. **Erection Contractors** Illinois Roofing and Insulation Company, Chicago, Illinois.

For a special problem —such as an "umbrella" for a sub-station— or for 1,000-and-1 typical industrial applications,

"CENTURY"

asbestos-cement corrugated roofing and siding is the satisfying, economical solution

"Century" Asbestos-Cement Corrugated solved an unusual problem at Bettendorf, Iowa. The 69,000-volt sub-station there of Iowa-Illinois Gas and Electric Company had an hour's service breakdown in early 1950. It was found that a sulphurous acid mixture of smoke and fog, swept in from a nearby generating station by the wind when in a certain quarter, had collected on the insulators and caused flash-overs or shorts. It was decided that the entire sub-station should be put under cover (which rarely, if ever, is done) as protection against this condition, and a steel framework covered with "Century" Roofing and Siding was erected. This "umbrella" has kept the insulators clear, and service uninterrupted.

In this, as in countless less unusual cases, experience has shown that "Century" Asbestos-Cement Corrugated is an ideal covering. It is composed of asbestos fiber and portland cement, subjected to pressure to form a dense product, strong and durable. "Century" Asbestos-Cement Corrugated *can't burn*, is highly resistant to weather, rot, rust, and corrosive fumes, is proof against rats, termites, and other destructive insects.

The moderate cost of "Century" Asbestos Corrugated, erection and low maintenance expense, all contribute to an economical installation. Additional and substantial savings can also be effected by using TOP-SIDE* Fasteners over any steel framework, which eliminates scaffolding. Once up it stays and needs no protective painting. Consider the savings in labor alone.

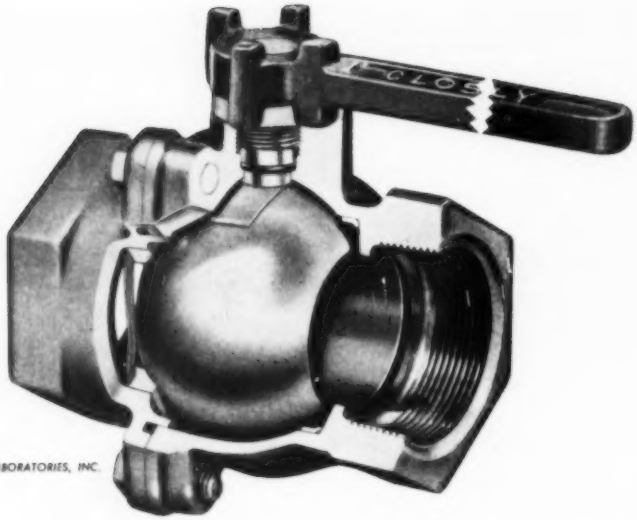
Write us for further details . . . and name of your nearest distributor.

*® H & B Enterprise Corporation

Nature made Asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

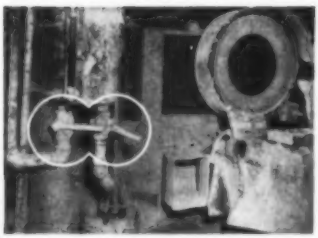
K&M best in asbestos



TESTED BY UNDERWRITERS' LABORATORIES, INC.

Breaking Records Throughout Industry!

FOR LONG LIFE . . . FOR ECONOMY . . . FOR SAFETY



Leading glass manufacturer reports Rockwood Ball Valves, operated 1500 times a day in a mixing process, were *only valves to stay in service over a year.*

Maintenance engineer of large gas company says: "Easy operation and no maintenance cost make Rockwood Ball Valves *far ahead of any others we have used.*"

On Texas transport firm's fleet of propane-butane trucks, the leakproof construction of Rockwood Ball Valves make them *safest for handling inflammable gases.*

Here's why Rockwood Ball Valves give you more of what you want in valve performance:

FULL ROUND FLOW . . . no change in shape or volume of the fluid stream . . . no turbulence . . . minimum friction loss.

QUICK OPENING AND CLOSING . . . needs only a quarter turn, even under full pressure.

RESISTS WEAR LONGER . . . scratching, pitting and abrasion have little effect on the chrome-plated, floating bronze ball.

STAYS LEAKPROOF . . . in closed position, pressure of fluid automatically positions ball against synthetic rubber seat to form a tight seal.

It will pay you to investigate how these advantages can benefit your own applications. Send for bulletin. Rockwood Sprinkler Company, 102 Harlow Street, Worcester 5, Mass. Distributors in all principal cities.

Some Prominent Users

Libby-Owens-Ford Glass Co.
Revere Copper & Brass, Inc.
Bird Machine Co.
Remington Rand, Inc.
Hub Machine Co.
Daggett Chocolate Co.
Also approved by Und. Lab. for L. P. G.

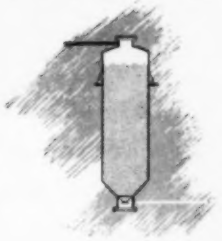
ROCKWOOD *FULL-FLOW* BALL VALVES

THE FLOW IS AS ROUND AS THE PIPE ITSELF

...two reliable names along the path of petroleum processing

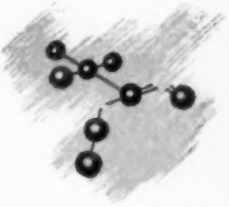
WHAT DO YOU WANT TO PURIFY?

There's an Attapulgus or Porocel adsorbent to fit your process technique for removing odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates from process liquids or gases. Materials treated in principal applications are: motor oils and other lubricating, specialty, and technical oils; petrolatums and waxes; aviation and motor gasoline stocks; kerosene; diesel and heating oils.



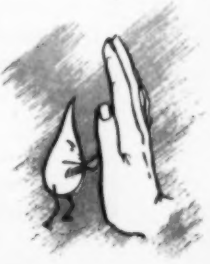
DO YOU HAVE CATALYST OR CATALYST CARRIER NEEDS?

Attapulgus or Porocel sorptive minerals are recognized standards in desulfurization, reforming and isomerization systems—catalytic removal of unsaturates—conversion of sulfides to elemental sulfur—fluid catalyst applications—as catalyst carrier in copper sweetening processes.



WHAT DO YOU WANT TO DRY?

We offer a wide range of reliable, thoroughly proved desiccants for drying air, hydrogen, carbon dioxide, hydrocarbon liquids and gases.



SPECIAL GRADES?

Mine and plant facilities permit prompt and economical production of grades meeting individual customer specifications. Our laboratories and technical staffs welcome the opportunity of assisting in research, development, design and operating problems. Your inquiries are invited.

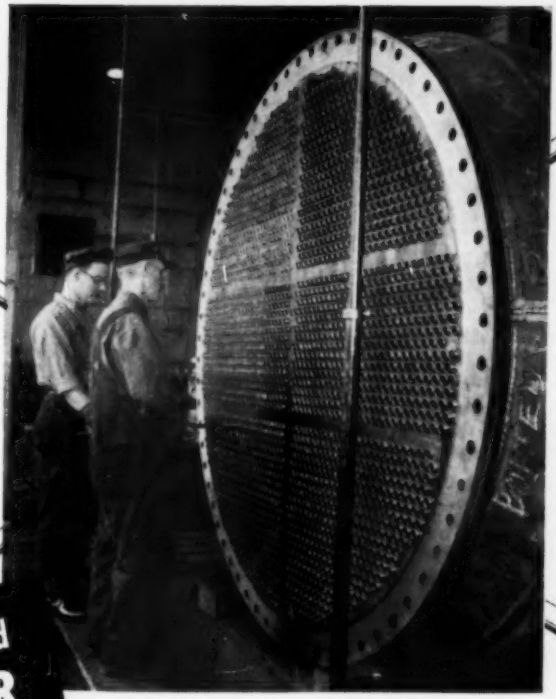
ATTAPULGUS CLAY COMPANY *Fullers Earth* · **POROCEL CORPORATION** *Activated Bauxites*

Dept. W, 210 West Washington Square, Philadelphia 5, Pa.

YOU CAN CUT CONTROL VALVE INVENTORIES *in half!*

ONE ANNIN VALVE BODY FOR THREE TYPES OF ANNIN OPERATORS

A single Annin valve body is standard for use with any of three types of Annin operators. Furthermore, each size of operator fits two sizes of valve bodies. Think how your inventory of critical control valves can be cut: For any installation the valve body is selected by size and alloy, then assembled with operator desired, and your control valve is complete (positioner unit built-in)—ready for service under specified conditions. In addition, all valve bodies carry a 1000# rating. Interchangeable flanges series 15, 30 and 60 are split-ring mounted to meet any requirement. Write today for detailed information. Ask for Catalog 1500B.



Highly corrosive liquor will be handled in this surface condenser fitted with Republic ELECTRUNITE *Stainless Steel Pressure Tubes.*

PULP and PAPER

...another industry that cuts costs with Republic

ELECTRUNITE PRESSURE TUBES

Whatever the product you are processing in heat exchangers, take a tip from the paper industry . . . even at the most corrosive stages in their processes, they use Republic ELECTRUNITE Heat Exchanger Tubes.

Where highly corrosive liquids must be handled, Republic ELECTRUNITE Stainless Steel Tubes add years of life between retubings, cut per-year costs, keep processes uncontaminated, maintain production. Carbon steel tubes are available for less active liquids.

ELECTRUNITE Pressure Tubes in both analyses are uniformly strong all around and end-to-end . . . and uniformly corrosion-resistant. They are fully normalized to provide clean surfaces inside and out, to assure tight rolling-in and smooth bends.

Mark your next order for heat exchangers "Republic ELECTRUNITE Pressure Tubes". . . make your next retubing job an ELECTRUNITE job.

50th ANNIVERSARY 1902 1952 STEEL and TUBES DIVISION

ELECTRUNITE TUBING

REPUBLIC STEEL CORPORATION

STEEL AND TUBES DIVISION

224 East 131st Street • Cleveland 8, Ohio

REPUBLIC STEEL

ELECTRUNITE

BOILER, CONDENSER AND HEAT EXCHANGER TUBES

Now, from Honeywell... *a flow*

Wherever supervision of your plant processes requires flow measurement, Honeywell has the right instrumentation for the job.

Included are instruments specifically designed for accurate metering and flow cost-accounting of process fluids, with either linear or square root scales and continuous integration . . . with a choice of electric or pneumatic transmission from the metering point.

Flow-measuring systems, including proper control, are patterned to your exact requirements . . . offer you the advantages of Honeywell's single responsibility from sensing element to control valve. Each part of the system is designed and built with the needs of process designers, production engineers and instrument men foremost in mind.

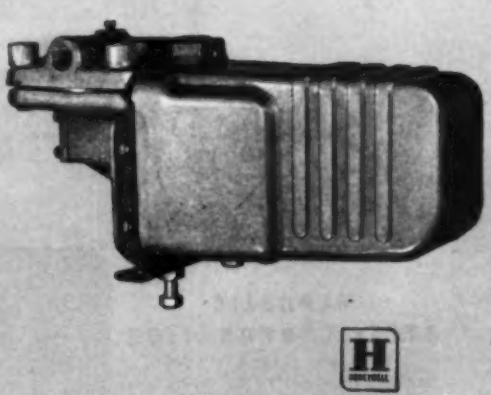
Call in our local engineering representative for a discussion of your application . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4498 Wayne Ave., Philadelphia 44, Penna.

BROWN DIFFERENTIAL CONVERTER

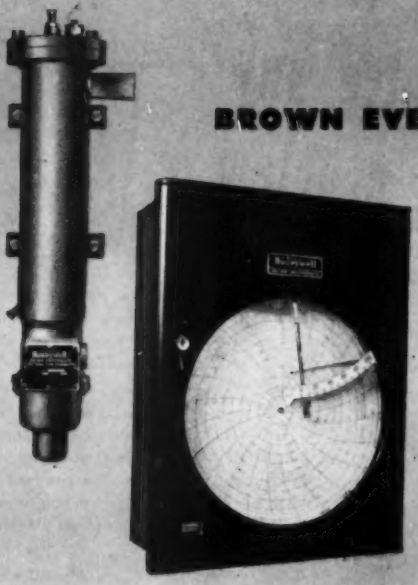
This new flow transmitter, based on the pneumatic balance principle, is setting high standards of precision and simplicity in field operation. Using no mercury, seals or strainers, it converts the pressure differential at the metering orifice into a proportionate air output pressure which is a measure of flow. Response is rapid and accurate. Range is continuously adjustable from 20 to 200 inches of water, and is easily changed in the field without special tools or extra parts. Applicable to either liquids or gases, the Differential Converter is easily installed, cleaned and calibrated in the field.

For graphic panels and other applications requiring compact instrumentation, the Differential Converter is part of a new Honeywell flow control family which includes Tel-O-Set Indicators, Recorders and Controllers. Write for "*Centralized Instrumentation — Unlimited*," a new brochure describing types of Brown panelboards and instrument components available for industry.



● *Important Reference Data* . . . Write for Catalog No. 2281 on the Differential Converter...

meter for every requirement



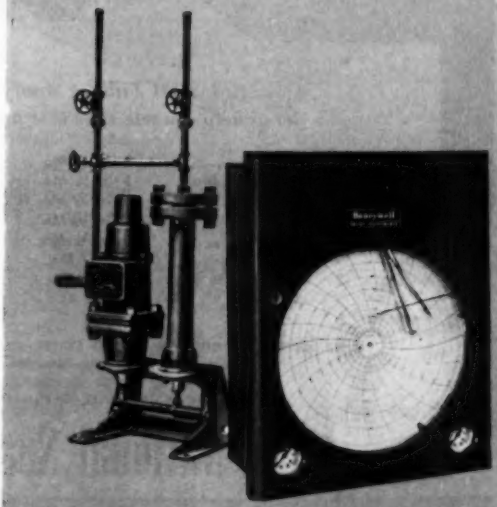
BROWN EVENLY GRADUATED FLOW METER

Costs for distribution and utilization of fluids can be accurately determined with this meter . . . available as a mechanical meter (with integral meter body) or as an electric meter (with electric transmission from remotely located meter body).

Features linear scale and electronic integration for simplified flow accounting. Electronic integrator is simple, accurate and easily accessible for calibration and inspection. Characterized corrosion-resistant bell automatically provides straight-line flow measurement.

BROWN SQUARE ROOT FLOW METER

This instrument's expanded, square-root scale affords extra sensitivity for automatic flow control applications. Available with on-off, throttling or Air-O-Line (proportional plus automatic reset) pneumatic control . . . Supplied for use with electric or mechanical meter bodies, in a wide choice of types: low pressure, intermediate pressure and all-purpose—plus sealed armature and area types for special fluids. Interchangeable range tubes afford broad flexibility in the field.



MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

Catalog No. 293-1 on the Evenly Graduated Flow Meter . . . Catalog No. 2822 on the Square Root Flow Meter.

Our case history files will help you solve any refinery tubing problem

● If you buy refinery tubing, you probably know quite a bit about steel analyses already. But it's hard to keep track of *every* steel tubing analysis, and just how it stands up under the countless combinations of heat, pressure and corrosive materials.

As the world's largest manufacturer of tubular products, we have a file of authentic case histories that covers many of the refinery tubing problems you will encounter. A problem that is new to you may be old to us. We may have encountered it before and solved it with one of our 23 different steel tubing analyses.

You can really use this information today, when so many grades of steel are in short supply. We'll help you select alternates that may do as good a job—sometimes at a lower cost than before.

Save valuable time by checking with us first when you are going to select tubing. There's no obligation, and we'll be glad to give you all the help we can. Write to National Tube Division, United States Steel Company, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

23 Steel Tubing Analyses

let us help you select the best for your job

Low Carbon	5 Cr, ½ Mo	17 Cr
Low Carbon, ½ Mo	5 Cr, ½ Mo, 1½ Si	27 Cr
½ Cr, ½ Mo	5 Cr, ½ Mo, Ti	18-8
1¼ Cr, ½ Mo	7 Cr, ½ Mo	18-8 Ti
2 Cr, ½ Mo	8 Cr, ½ Mo	18-8 Cb
2¼ Cr, 1 Mo	8 Cr, 1 Mo	18-8 Mo
2½ Cr, ½ Mo, ¾ Si	9 Cr, 1 Mo	25-20
3 Cr, 1 Mo	12 Cr, Al	

All National Seamless Tubing is pierced from a solid billet of high-quality steel. This is the one manufacturing method that removes all doubt concerning uniform wall strength.

USS

NATIONAL TUBE DIVISION, UNITED STATES STEEL COMPANY, PITTSBURGH, PA.
(Tubing Specialties)

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S National Seamless Pipe and Tubes

UNITED STATES STEEL

This is Controlled Volume Pumping

Pumping 0.74 gph of concentrated odorant into natural gas.
Temperature: 70° F.
Discharge Pressure: 300 to 600 psi.

THIS MILTON ROY CONTROLLED VOLUME PUMP DOES THE JOB . . .

It's "miniAir"—the compact, Milton Roy air-powered "miniPump"—complete with accessory control equipment. At a large mid-western plant, this efficient pump ties into the gas main line flow, pumps odorant in controlled volume in relation to flow. Field reports show that odorization is accurate, complete, unfailing. One of many types of Milton Roy Air-Powered Controlled Volume Pumps, this particular "miniAir" has a capacity range of 3 to 3200 milliliters per hour, against a discharge pressure varying between 300-600 psi. Accessory controls shown are fundamental "engineered" components of the odorization system.

Odorization of natural gas is just *one* application of the Milton Roy principle of controlled volume pumping. Milton Roy Controlled Volume Pumps are widely used elsewhere in the petroleum industry—for pumping distillates, solvents, furfural, liquefied petroleum gases, tars, sludges, asphalts, petrolatum. They are used for the addition of inhibitors, controlled catalyst make-up, and for other processing techniques.

Milton Roy Controlled Volume Pumps do things ordinary pumps couldn't be expected to do, perform flawlessly on services where no other pump has filled the need. They have the advantages of design simplicity, low upkeep, low cost.

For additional information, call the Milton Roy representative listed in your telephone directory. Or write us direct.

WITH THE EXCLUSIVE STEP-VALVE DESIGN

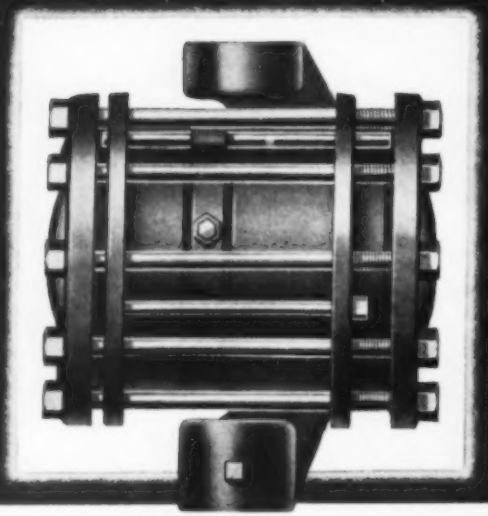
MILTON Roy COMPANY

1315 EAST MERMAID LANE, PHILADELPHIA 18, PA.

MANUFACTURERS OF CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

Now AMERICAN® offers...

THE *NEW* MERCURYLESS ORIFICE METERS



- ONE PIECE STAINLESS STEEL BELLOWS—minimizes metal fatigue for long service life.
- DIRECT FULL SCALE RECORDING PEN MOVEMENT—no external gearing or linkage multiplication.
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- AMERICAN TYPE "B" TEFLON SEAL STUFFING BOX—no lubrication, no shaft freezing, no leaks.
- STICK PROOF CHECK VALVES—protect bellows against over-range damage or distortion.
- SIMPLIFIED RANGE CHANGE—no disconnecting manifolds.
- EASY CALIBRATION AND CLEANING—by simply removing one or both case cover heads.

NO PRECISE LEVELLING OR SEAL POTS REQUIRED.

FOR PEDESTAL, PANEL OR OVERHEAD MOUNTING—TOP OR BOTTOM GAUGE LINE CONNECTIONS.

Dri-Flo Meters are the latest addition to the American line—developed under the Company's century-old tradition of "Sustained Accuracy at Lower Cost."

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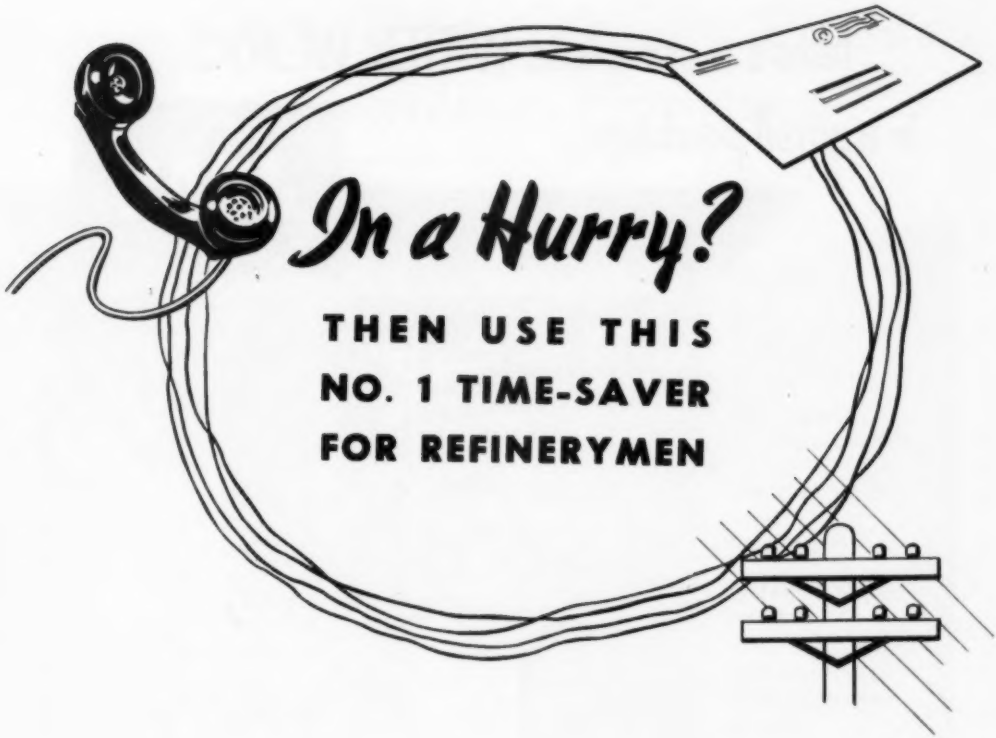

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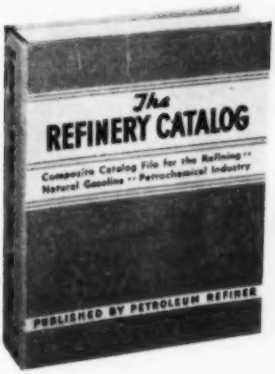
THEN USE THIS NO. 1 TIME-SAVER FOR REFINERYMEN

When every hour saved means money . . . when equipment needs replacing . . . when comparative product information is needed immediately to complete a project estimate . . . when questions of varied applications and detailed specifications need answering . . . when these and a hundred other reasons for saving time come up—just "reach for your *Refinery Catalog!*"

You'll find catalog data on equipment and services of more than 300 manufacturers listed in the current 1952 edition. No wonder *Refinery Catalog* is used as the preferred source of buying information among refinerymen the world over.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REFINERY CATALOG
Composite Catalog File for the Refining -- Natural Gasoline -- Petrochemical Industry
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REFINERY CATALOG

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here's a complete WATER WORKS in a small package...

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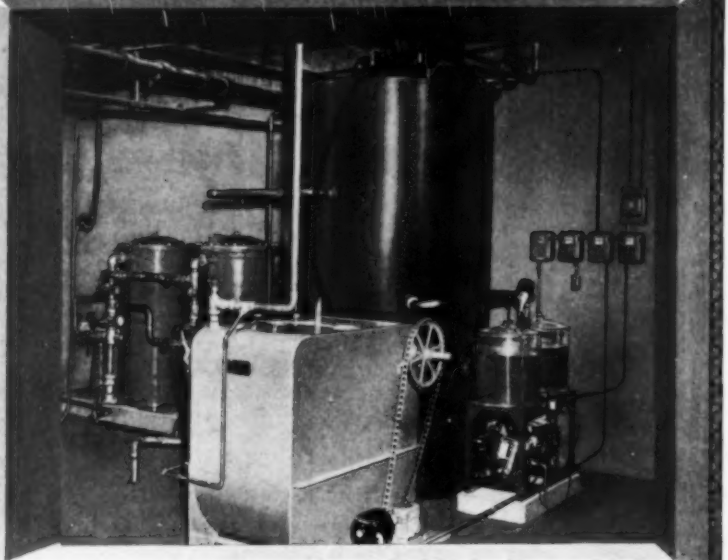

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The JBAS doesn't care if your source of water is creek, river, lake or well. It is equally effective for softening, clarifying, sterilizing, or removing organic matter, tastes, or odors. Its versatility has been demonstrated in hundreds of installations treating 5 to 100 gallons per minute, providing a water equal or superior to large municipal supplies.

Ask for Bulletin 1845

and see how a JBAS conserves space and installation costs. Learn how and why JBAS gives uniformly satisfactory results with minimum supervision and attention. Note it can be readily moved, too, if necessary.

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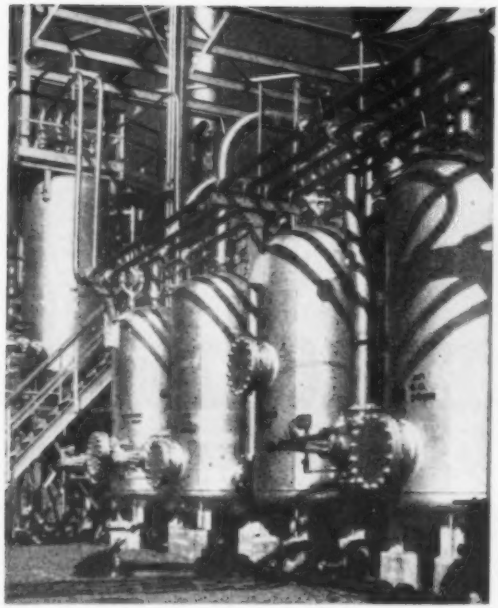

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Since 1881

Soda Ash · Caustic Soda · Caustic Potash · Chlorine
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Want to be certain of quality and uniformity in the chemicals you use for processing operations? Make sure you get them from SOLVAY—America's leading producer of alkalies and associated chemicals! You can also depend on SOLVAY for *service*—for helpful *sales* service from thirteen sales offices and a nationwide chain of distributors; for *delivery service* from centrally-located plants and over 200 coast-to-coast stock points; and for an exclusive Technical Service for the petroleum industry.

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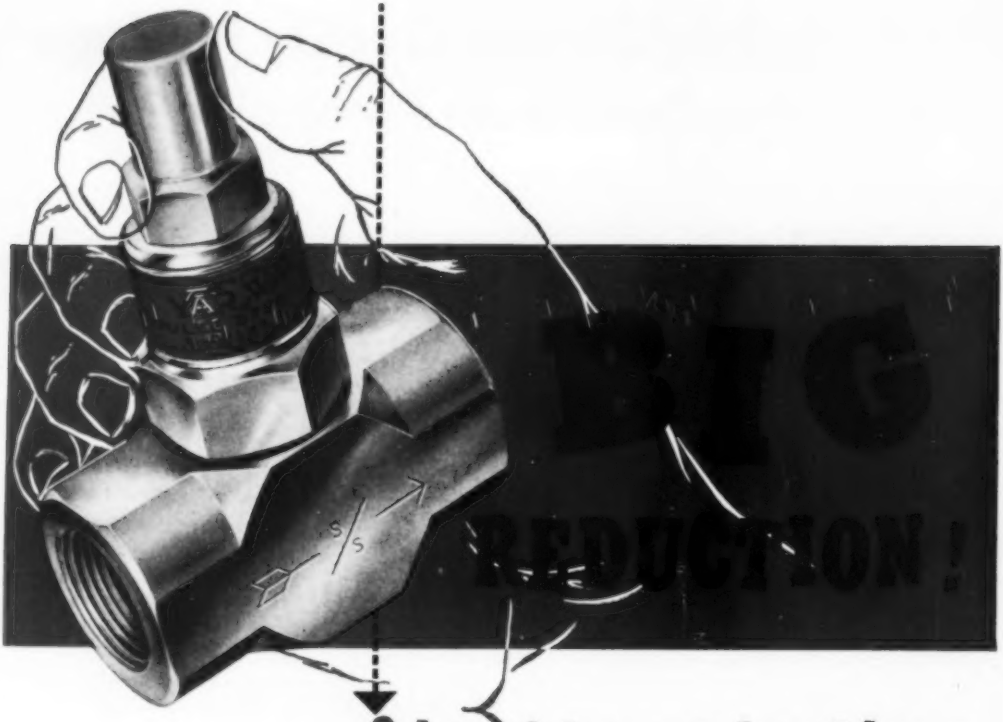


8-hour job now takes 4 hours

At a western magnesium reduction plant something besides magnesium has just been reduced. The steam at the end of the 1½ mile long steam line wasn't so hot—and neither was the production record of the plant at that location.

Then 26 old-type steam traps were replaced with Yarway Impulse Traps. Now there is only a 15° temperature drop from the boilers to the end of the line. *Most important, the plant 1½ miles from the boilers is now able to do work in 4 hours that previously took 8 hours.*

That's trap efficiency! It's evidence of the fact that Yarways are designed to send the most premium B.T.U.'s at top temperatures into your process or product. *They get equipment hotter, sooner . . . and keep it hot.*

Other Yarway features—small size, one moving part, easy installation, low maintenance, low cost, stainless steel construction. Nearly 750,000 Yarways have already been installed. For your Yarways, see a nearby industrial distributor . . . 216 stock and sell Yarways.

YARNALL-WARING COMPANY, 128 Mermaid Ave., Philadelphia 18, Pa.

FREE TRAP SELECTOR

It's important to have the right trap in the right place. New 20-page selector tells quickly and easily which *is* the right Yarway trap for any application. Write for your free copy.

YARWAY

the steam trap

designed with more production in mind

Our Readers' Comments

Congratulations

Dear John McKetta:

This letter is being written to express the hope that your new work with Gulf Publishing Company will bring great joy to your heart. I am certain that grand success will attend your efforts.

The world in which we live is still a good place in which to live so long as we continue to be kind, thoughtful and considerate of one another—a world which needs our services so long as we render them in the proper spirit.

I hope ardently that all of the good fortune for which your heart may yearn may be yours.

CARL J. ECKHARDT,
Director of Physical Plant,
The University of Texas

Austin, Texas
May 28, 1952.

Dear Carl: You have your many friends because you practice the second paragraph of your letter yourself. We envy you.

Dear John McKetta:

Welcome to a fellow Editorial Director! Jim Lee told me about your new job with Mr. Dudley. I am certainly very pleased to hear about it and hope you will find as much fun and satisfaction out of your work as I have over the years.

With best wishes and good luck,
Sincerely,
SIDNEY D. KIRKPATRICK,
Editorial Director
Chemical Engineering and
Chemical Week

New York City
June 6, 1952.

Thank you, Sid. A very nice letter from the top notch "Mr. Chemical Engineer" of "Chemical Engineering."

Our many thanks to so many of you friends who sent letters and phone this office with your congratulations and best wishes for Bob Phillips and me. It's such a nice feeling to have so many wonderful friends.

Kobe Again

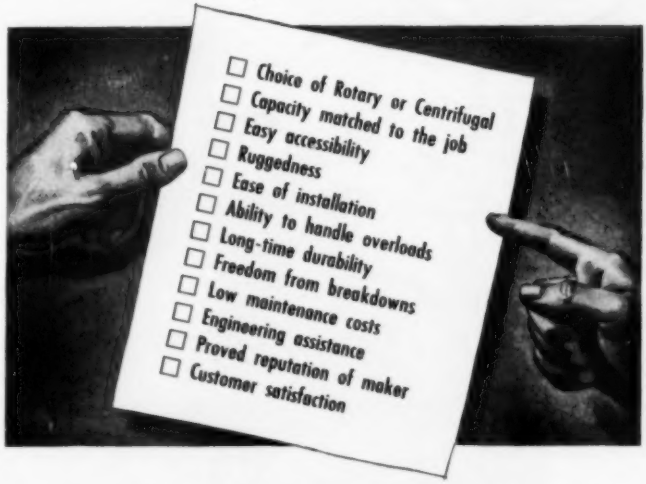
Dear Sir:

"Extractive Crystallization—A New Separation Process" by Kobe and Domask is one of the finest technical articles I have read in recent months. Let's have more like this one!

DR. SIMON MIRON,
Pan American Refining Corp.,
Texas City, Texas

Dr. Kobe is an artist at writing interesting material. As an author of several books and almost 200 technical papers, he is at home with a typewriter. We will have more of Kobe in near future. Bill Domask spent many, many hours obtaining the information for this series. Lucky Humble

BEFORE BUYING *any* BLOWER COMPARE THESE ESSENTIALS


☐ Choice of Rotary or Centrifugal
☐ Capacity matched to the job
☐ Easy accessibility
☐ Ruggedness
☐ Ease of installation
☐ Ability to handle overloads
☐ Long-time durability
☐ Freedom from breakdowns
☐ Low maintenance costs
☐ Engineering assistance
☐ Proved reputation of maker
☐ Customer satisfaction

When production depends so vitally on adequate handling of gas or air, you can't afford to take chances on the performance of your blowers or exhausters. It's better to be safe than sorry.

So, for new installations or replacements, we suggest that you evaluate the equipment by the above standards of comparison. This will help determine the unit that will be most effective, economical and reliable for your specific applications.

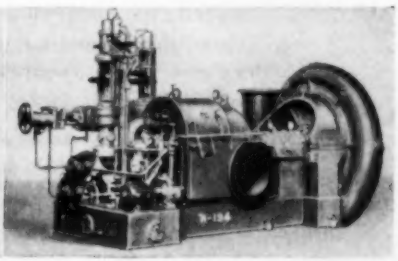
Be sure to include the R-C *dual-ability* line of both Centrifugal and Rotary Positive types. Remember, that only we offer you this *dual choice*—with unbiased recommendations from almost a century of experience. With capacities from 10 cfm to 100,000 cfm or higher at moderate pressures, R-C equipment has a long record of outstanding performance in industrial applications.

We'll gladly send detailed information for comparison—or supply engineering help if we can be of service.

ROOTS-CONNERSVILLE BLOWER CORPORATION
521 Crescent Avenue, Connersville, Indiana

CENTRIFUGAL

Type OIS Gas Exhauster. Capacity 19,000 cfm, driven by 332-hp steam turbine.

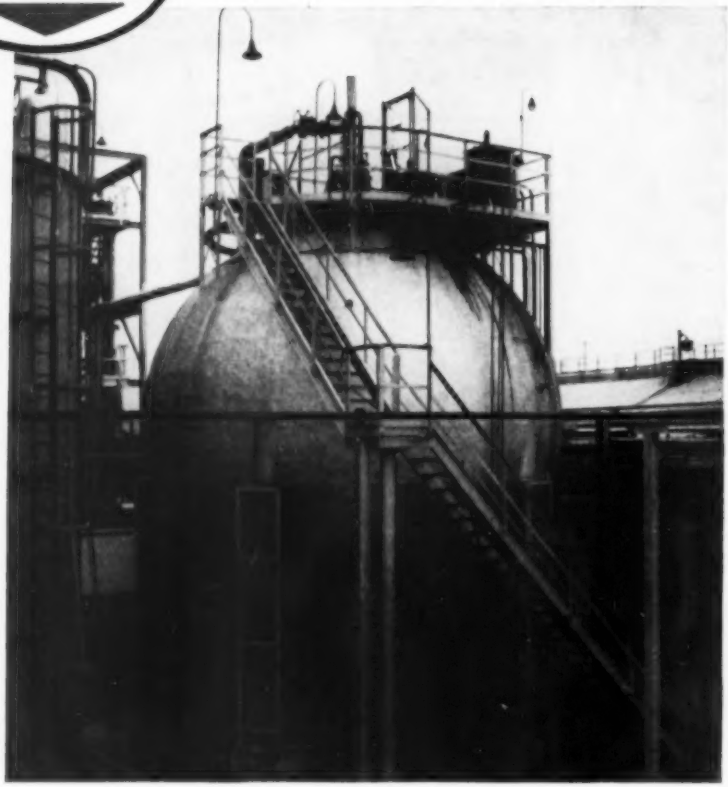


Reg. U. S. Pat. Off.

ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1854
ONE OF THE DRESSER INDUSTRIES

SOHIO

another leading refiner who desalts with PETRECO



The Standard Oil Company of Ohio is a long-time user of Petreco Electric Desalting. Like many other oil industry leaders, Sohio installed a Petreco desalting plant in one refinery, then repeated with Petreco in another.

The merit of a refining process often can be appraised by the caliber of the refining organizations who install, use and re-order. Petreco invites you to check into the large number of leading refiners who, like Sohio, use Petreco Electrospheres.

For descriptive literature and complete information on Petreco desalting, call or write

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PETRECO
PURIFICATION AND TREATING PROCESSES

ELECTROSPHERE DESALTING • ELECTRIC DEHYDRATION
ELECTREATING OF DISTILLATES: ACID, CAUSTIC, DOCTOR.
ELECTRIC DESAPONIFICATION OF FUEL STOCKS

Letters

Oil & Refining Company will get Bill in September.

Maintenance Problems

Dear Sir:

I have been a reader of the PETROLEUM REFINER for a number of years and have enjoyed every issue. Its news coverage of construction being done all over the world is of great interest. Its technical articles have been not only enlightening but very interesting. The most valuable department in the REFINER, and to me, the most interesting, however, is the maintenance section, in which are presented both readers' reports on how they carry on a particular job at their refinery and special articles devoted to maintenance.

A suggestion: As a means of developing interest and hearing all sides of a problem—why not invite PETROLEUM REFINER readers to comment and offer improvements to the improved methods presented in earlier issues? Their letters could be printed at the end of the department each month and a round table discussion carried on.

The petroleum industry has not given as much thought to long range low cost maintenance planning as have certain others. Apparently well planned refining units are erected without sufficient emphasis being given to repairs. Built-in handling facilities are added sometimes several years after the unit has been operating. It is true that frequently the amount of repair work necessary to be done on a particular section cannot be foreseen, but in some instances the problems of repairs are overlooked entirely. As an example: A cooling tower may be constructed without access roads. Exchangers may be installed at a great distance from the ground or in inaccessible locations without handling facilities with which to remove the tube bundles. Boilers are erected with access doors so small that they may be entered only with difficulty and repair materials such as bricks must be passed into the fire box one at a time. These oversights can mean only one thing—high maintenance cost.

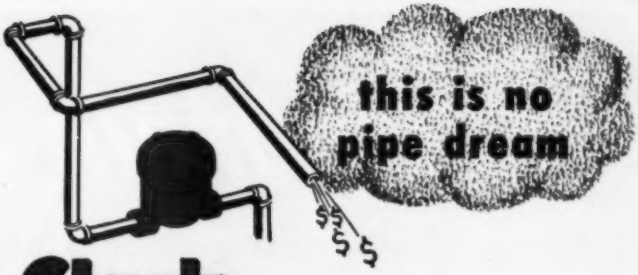
Your "How to Do It" section offers an effective means of combating some of these problems and I am always interested in learning how the other fellow does his job. For this reason I would like to see this department enlarged and more down-to-earth maintenance methods presented. I would like to see more special maintenance articles.

G. M. TALTON,
Mechanical Engineer
2200 Alabama Street,
Baytown, Texas
June 22, 1952.

We're doing our best to anticipate your needs, Mr. Talton! Take a look at the three maintenance-type articles in this issue. You have some very good ideas in this letter.

Note

As indicated in "The Look Box," the Editors of PETROLEUM REFINER are quite anxious to hear from readers and the plan is to reproduce each month at least a selection of the letters received. Discussion of timely topics can be as interesting on the printed page as at "bull sessions." So chime in anytime you feel like it.



Clark CONTROLS CAN SAVE YOU MONEY

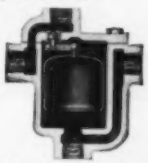
All Down the Line!

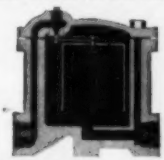
If dollars are running through your steam lines it's time Clark Controls took over. Water in steam lines wastes fuel, cuts efficiency and adds greatly to maintenance costs.

Clark Steam Traps, with Duo-Stop Leverage, drain *twice* the condensate of ordinary traps. Clark Controls on your lines is truly like money in the bank. Write us for full details.

QUICK CLEANING STRAINERS

Remove dirt, scale and grit from steam, fluid and gas lines. Sizes ½" to 3" P.S.I.



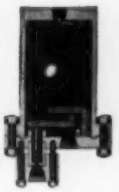


SERIES "70" Inverted Bucket Trap

One of the most popular in the Clark line. Continuous flow capacities up to 2600 lbs. per hour. Sizes ½", ¾" and 1". Pressures up to 200 P.S.I.

SERIES "60" Inverted Bucket Trap

Choice of horizontal or vertical inlet or outlet. For pressures up to 150 P.S.I. "Clark-loy" guided disc and seat.



SERIES "450"

For continuous flow drainage. Pressures up to 600 P.S.I. Sizes ½" to 2". External discharge valve; "Clark-loy" disc and seat.

THE CLARK MANUFACTURING COMPANY

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Clark

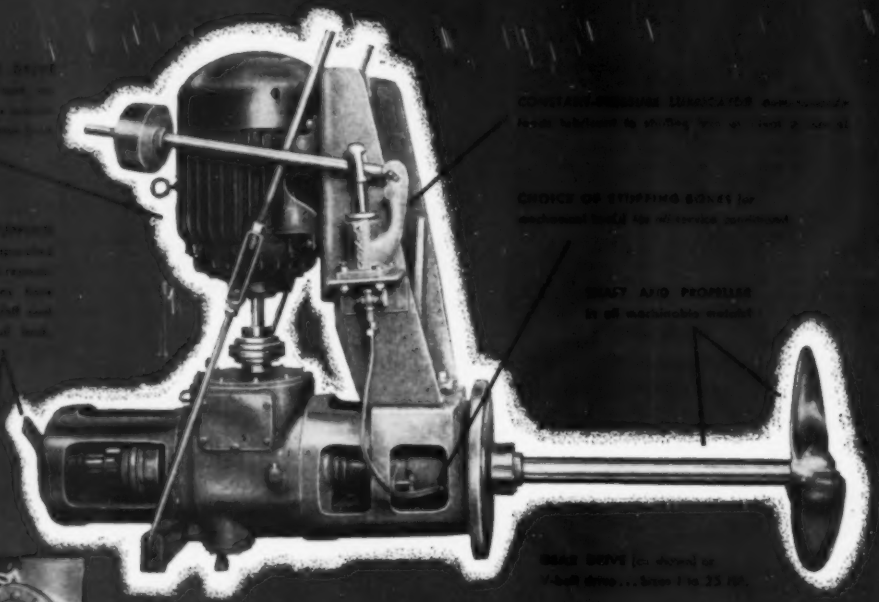
THE HOME OF DUO STEP LEVERAGE

The complete line of dependable fluid controls

EASIEST MAINTENANCE EVER!

NEW Lightnin® Mixers

For low-cost blending—mixing—agitating in tanks up to 5 million gallons



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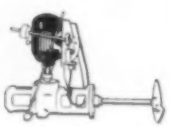
FOR PARTICULARS, call your MIXCO representative, or write us today.

MIXCO

fluid agitation specialists

EVERY *LIGHTNIN* MIXER IS GUARANTEED TO DO THE JOB *RIGHT*

PORTABLE
⅛ to 3 HP



SIDE ENTERING
1 to 25 HP

TOP ENTERING
¼ to 500 HP

MIXING EQUIPMENT Co., Inc.

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In Canada: William & J. G. Greey, Ltd., Toronto

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- ☐ B-76 Side Entering Mixers
- ☐ B-78 Top Entering Mixers (propeller type)
- ☐ B-75 Portable Mixers (electric and air driven)
- ☐ B-101 Condensed Catalog showing complete line
- ☐ B-102 Top Entering Mixers (turbine and paddle type)
- ☐ DH-50 Laboratory Mixers

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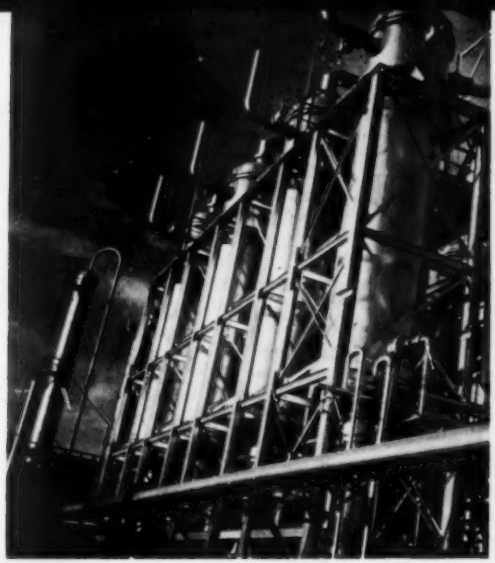
PETROLEUM REFINER

The LOOK BOX



Check These Items

1. SULPHURIC Acid, 60 deg., is $9.00 per ton.
2. The New Hoge Cracking Process is now being tested in Houston.
3. American Chemical Society now forms division for Petroleum group called "Petroleum Chemists Division."
4. Freight rates reduced from Oklahoma points.

These are a few of the many items which appeared in the September and October, 1922 issues of *The Refiner*. These happened to be Nos. 1 and 2 of Volume 1 of this present PETROLEUM REFINER. The very first article of the October, 1922 issue happens to be one of the first papers published by our dear friend N. A. C. (Nick) Smith, the famed Bureau of Mines Chemist. The world lost Nick on May 19, of 1952.

I was only six years old when this first issue appeared. Tonight, just about 30 years later, I am trying to write my very first item for this "Look Box." My Boss sat at his deck 30 years ago and wrote. He wrote lots of things for the first issue. The best thing he wrote was on page 6 where he tells the purpose of the new publication. "It *(The Refiner)* will bring to its readers each issue new data on refinery methods, written by men who are in a position to write with authority. It will bring to you information on new processes . . ." A lot more is written, a total of 494 words, and we are mighty proud that the Boss has kept his promise, making this the top magazine of the refining, natural gasoline and petrochemical field.

How many of you remember the first issue? We would like to know. How many of you still own the first issue? We would pay you very handsomely for an original copy of this first issue.

A Section For You

BEGINNING with this issue we are planning a section to be written by you. This section will be called *Our Readers' Comments* and will be found on page 61 of this issue. We invite your comments, good or bad, about the PETROLEUM REFINER, the articles, the writers, the staff, your neighbors or your employers. In fact you may comment about other commenters if you wish. Perhaps you have a lot of pet gripes that you would like to get off your mind. Here's a good place to do it!

Increased Emphasis on Maintenance and Operation

OIL INDUSTRY representatives at our annual Editorial Conference urged that PETROLEUM REFINER increase its coverage of the maintenance and operations fields.

Beginning with this issue, our readers will see the realization of those suggestions. Bob Phillips, a highly capable engineer with wide experience in industry, has been added to our staff and will devote a large part of his time to these important topics.

Three very important papers are presented in this issue. "White Paint Cuts Storage Loss" presents important and somewhat sensational data on the advantages of white paint over aluminum paint for storage tanks. An operations article describes the very ingenious solutions to some extremely difficult instrumentation problems. A second maintenance article, directed to all refinery people interested in design and in construction materials, paints the progress of the use of aluminum with many specific and helpful suggestions for its application.

These articles represent a red-hot emphasis on giving maintenance and operations men the answers they need.

Letting George Do It

LOOKING BEYOND the present steel strike and into the causes of our centralized government, B. Brewster Jennings, President, Socony-Vacuum Oil Company, defined the problem at a recent meeting in this manner:

"Nobody should be satisfied with the way this

Top-of-Page Photo—One of the Multiple Reactor Units for Producing Chemicals from Natural Gas at Celanese Corporation of America Plant, Bishop, Texas.

High tinctorial strength

of DU PONT OIL BLUE A helps keep engine intake system deposits at a minimum

DU PONT OIL BLUE A is available for use in both aviation and motor gasolines. This single component dye dissolves rapidly in gasoline and other petroleum fractions. It can easily be added in concentrated solutions with proportioning equipment, or directly by means of a "dye pot."

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Due to its many desirable characteristics, Oil Blue A is used to color Du Pont Tetraethyl Lead Compound—Aviation Mix, where it provides a base for all three standard aviation gasoline colors. Why not ask your Du Pont Petroleum Chemicals Division representative for a sample?

SOLUBILITY—The solubility characteristics of Oil Blue A in gasolines will vary according to their composition. However, the following guide for approximate solubilities in typical gasoline components may be helpful:

APPROXIMATE SOLUBILITY . . . . Grams/100 U. S. Gal.	
Straight Run Gasoline	760-950
Thermal Cracked Gasoline	1150-1500
Aviation Gasoline	570-760
Benzene	28400-32000

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steel wage price matter has been handled by the government, and I doubt that anybody is. However, instead of blaming it all on the Arnalls, the Feinsingers and the government in general, should we not ask ourselves whether we the people are not primarily the ones at fault? Haven't we perhaps asked our government to do something that none of us felt able to do? Haven't we forgotten that our government is not the Almighty, but is people just like we are? Isn't it, in fact, a very vital question whether by legislating all sorts of well nigh impossible new duties for government to perform we haven't substituted a cumbersome, expensive, and ineffective process for the perhaps imperfect, yet ultimately effective process of working out problems privately with others as individuals? I wonder whether this trend isn't an indication of moral bankruptcy expressing itself in a sort of national 'Let George do it' philosophy, aggressively promoted by those who lust for power, with the misguided assistance of those who think the remedy for all our ills consists of giving unlimited power to someone in Washington with good intentions.

"We hear much these days about indiscretions, and downright corruption in government circles. There have been so many instances wherein the charges have been well founded that I think we must concede that we have more of that sort of thing than we used to have. A good many people are saying that it is all the fault of the incumbent administration, that it has been in power too long and that it has become corrupted thereby. This is the easy view to take, and of course there may be something to be said for it. However, perhaps that isn't the whole answer. Perhaps this business of corruption in government is influenced to some degree by the kind of things we have been making the government do for us."

Why All This 'Security' Talk?

YOUR EDITOR has had considerable contact with interviewers from industries seeking college graduates. The employers find one question paramount in the young graduates' minds "what do you have to offer in the way of security?"

What do they mean by security? Do they want a steady job the rest of their lives, with a guaranteed safe salary, plus a fat retirement income? Do they want assurance that they can keep their jobs, without fear of being fired for incompetence, or being outdistanced by their competition? Do they have the desire for "something for nothing" deeply ingrained in their hearts?

Apparently the discouraging answer is "Yes!" Sociologists can tussle with reasons for these attitudes—war and international unrest, socialistic trends of the government, lack of faith in the future.

We don't know what to do about all this but we are in thorough accord with Benjamin F. Fairless who says it's all wrong. In a commencement address delivered at USC, Mr. Fairless, worried about this modern preoccupation with security had this to say: "It is negative and defensive at a time when we ought to be positive and dynamic."

He visualizes that the facets of security are "*spiritual*, which is faith in divine guidance; *physical*, or the ability to plan for the future with reasonable expectation of living to enjoy it; *political* security—or simply, freedom; *psychological* security, which is really just plain confidence in yourself . . . you don't get it by dodging the battles of life, you get it by fighting and winning them."

Clothed In Oil

DR. GUSTAV EGLOFF, Universal Oil Products research director, foresees the day when the world will be clothed in oil. A spokesman whose name is synonymous with petroleum chemistry research, Dr. Egloff, speaking before the Rotary Club of Houston, recently, put his case this way: Nylon and the newer fibers including dacron, orlon, dynel and acrilan are based on chemicals obtained from petroleum or natural gas. Benzene for nylon and p-xylene for dacron are both produced by Platforming gasoline fractions. Ammonia for nylon and for the acrylonitrile used in orlon, dynel, and acrilan is obtained from natural gas. Ethylene glycol for dacron is a product of ethylene from cracked gases. Other materials for acrylonitrile are ethylene or acetylene and these gases are also the base for vinyl chloride which is used in dynel. Many of the processing chemicals are also from petroleum or natural gas.

Production of these synthetic fibers should reach about one billion pounds per year in 1960 which represents a very rapid growth from the 1950 production of about 145 million pounds, most of which was nylon. These fibers have the advantage over the natural of being uniform and therefore of known and precise quality. Each has its special characteristics which are adapted to certain uses. This field is just in its beginning stages; yet improvements and new fibers are being developed rapidly. There is high probability, indeed, that the entire world may some day be clothed in oil.

All of the basic chemical components of fibers, plastics, and rubber have high versatility which increases their economic attractiveness. A case in point is the development of "Mylar," a strong film, from the substance used for the new textile fiber, dacron. This film is particularly well suited for electrical insulation. It retains dimensional stability with changes in heat and humidity, retains flexibility at low temperatures and is chemically resistant. Other anticipated applications include light weight storm windows, collapsible tubing and packaging.

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INTEGRAL MOTORS tough and sturdy backed by the Crocker-Wheeler reputation and experience. All types, including the always dependable totally enclosed fan-cooled SEALEDPOWER motors.

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H2-3

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Employe Relations Manager, W. P. Reymond, Jr., asks the "Big Question" as a group of prospective Annuitants look on. The answer to "When does an Esso employe begin preparing for retirement is: "When he is employed by the company and signs up under the benefit plan." Similar charts are used throughout the course to drive home important points.

Retirement Like Graduation— Many New Opportunities Beckon

Esso Standard urges annuitants in carefully supervised sessions to plan their retirement so they will stay healthy, happy and busy

B. H. FARRIER, T. S. KEATY
Esso Standard Oil Co., Baton Rouge, La.

ONE day recently at Esso Standard Oil Company's Baton Rouge, La., Refinery 15 men were gathered around a conference table planning *new* careers. They were not new employes or newly-hired technical men indulging in the dreams of youth, for their hair was tinged with white and their faces showed the passage of years—but interest shone from their faces and their eyes were bright with anticipation as they exchanged ideas on retirement activities. It was the last or "round-table" session of the Esso Company's "Preparation for Retirement Program," and the careers planned were those one can have after age 60 to 65 on an assured annuity income. Comments passed rapidly back and forth as ideas for retirement careers were aired:

"I plan to buy a trailer and travel for at least the first year of my retirement," said an electrician of 60 who was retiring after 36 years with the company.

"My career will be that garden of mine," his boilermaker neighbor of 65 replied. "I'm going to raise more vegetables than my family and all the neighbors can use."

"That little farm of mine will take up most of my time," was the comment of a gray-haired pipefitter. A lanky, pipe-smoking accountant in the group stated that his part-time job with his church would be expanded into a full-time job when his retirement became effective.

In this way the company's preparation for retirement program helps employes make the adjustments incidental to retirement from active work, and encourages them to plan ahead for the retirement years. Adapted from a similar program developed in the Esso Company's eastern refineries, the program now has been in operation since November, 1951. Four groups of prospective annuitants, totaling 75 employes, have participated in the program. Courses are offered and start several years in advance of actual retirement.

The results so far? "Excellent" is the word used by management people who have had contact with this first phase of the training.

What about the comments of the prospective annuitants who have been through the five one-hour discussion periods? "Unusually appreciative" sums up their comments and attitudes; however, only time can tell how effectivey these men in their retirement years will use the knowledge gained in the course.

Sparking the program is a 60-minute sound motion picture in color, made by the company on the activities

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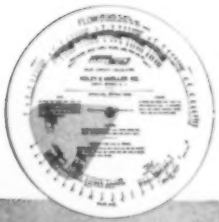

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of 12 refinery annuitants. This picture, entitled "Harvesting the Years with Esso," is shown in the fourth session of the program. The content of each of the five sessions of the course is outlined below:

The Philosophy of Retirement

The first meeting, entitled "What is Retirement?", conducted by the plant manager of employe relations, sets forth the basic idea of the whole series by getting the men to look upon retirement as the start of a new career, rather than as the end of the road, the scrap heap, or being "put on the shelf." Retirement is pictured as graduation time—the opportunity to do the things one has always wanted to do, but did not have time to do. In this new career one's needs are the same as they have always been, i. e., companionship, adequate finances, a sense of achievement, to be busy, and to be useful. These needs can be met by the assets that one takes into retirement, such as: an assured income, an established place in the community, and worthwhile skills and wisdom. Each conferee is asked to check his plans against these basic needs in order to determine if his plans are really going to give him what he wants.

At the first meeting the employe relations manager emphasizes that although the meetings are held during regular work hours, attendance is strictly voluntary. It is made clear that the company does not intend to interfere with the conferees' personal business or to try to influence them unduly in their retirement plans. It is made clear that the sole purpose of the meetings is to help the prospective annuitant help himself.

Health Program

The second meeting, conducted by the refinery medical director, is devoted to developing a pattern for health in retirement. A six-point program is set forth, embodying the idea of moderation in all things and keeping the mind and body busy. The men are impressed with the need of regular physical check-ups. As a means of avoiding monotony and frustration, it is suggested that they keep busy, mentally and physically, within the limits of individual ability. The increased span of life of older people due to medical advancements is shown dramatically on charts, indicating that at retirement age, the average individual still has the prospects of years of happy, healthy life.

"Although we decline physically with age, we remain mentally alert," the medical director tells them.

How to Plan

The third session, conducted by the head of the plant Annuities and benefits department, is devoted to the detailed planning of one's retirement years. Each conferee is given a written statement showing the company's estimate of his retirement income from the various company plans and from social security. With this basic financial information in hand, the prospective annuitants are given a general pattern for planning retirement and are urged to use this pattern—"A Planned Retirement is a Successful Retirement."

Bennett H. Farrier, head of the Plant Annuities and Benefits Department, reviews with prospective annuitants the income they will receive from their Annuity Plan. Each man is given a written estimate of what his retirement income will be.

Movie at Fourth Meeting

The fourth meeting consists of showing the motion picture "Harvesting the Years with Esso," which shows how 12 Esso employes are living in retirement.

The film is introduced by a member of the Training department who suggests they look for evidence of sound planning of time and finances in the case histories shown.

After the movie, the cases are analyzed by the conference method to stress important points in planning retirement, such as the use of skills gained while actively at work; the expansion of hobbies into pleasant and profitable retirement activities and the possibilities of community service. Some of the important points made are:

"Your choice of retirement activities is unlimited but only you can make the choice."

"A happy retirement does not come without planning"—what you are going to do, how you are going to do it, and consideration of your abilities.

"Retirement is the freedom to do as you please, to do the things you have always wanted to do."

"A planned retirement is a happy retirement."

Round Table

The fifth meeting is the round-table discussion in which each man has a chance to exchange ideas with the group in regard to retirement plans. Quite a few on entering the program had no definite plans for retirement, but by the time they reached the last of the five sessions their plans had crystalized to such an extent that they could tell the group how they wanted to spend their time in retirement. The vice president, who is also general manager, opens his final meeting and congratulates the prospective annuitants on their "approaching graduation" from active service. He talks to them informally for 10 or 15 minutes. He also presents each of the participants with a personally autographed copy of the book, *How to Retire and Enjoy It* by Ray Giles.

Synopsis of Film

The sound motion picture, entitled "Harvesting the Years with Esso," approximately 60 minutes in length, opens with a brief pictorial history of the refinery, and also employs old news-reel shots of events contemporary with the refinery's early days. Antique photographs from the refinery archives also are reproduced and included in the film, and are quite effective in the finished picture, as these old scenes and motion pictures remind the annuitants of their earlier days. As the growth of the refinery con-

Prospective annuitants view Esso's sound-color motion picture, "Harvesting the Years with Esso." The scene shows plant annuitant Lando Charlton, former Sweaterman at the refinery, as he works on his farm with his 10-year-old nephew, Mac Charlton.

tinues, the parallel development of the company's retirement or annuity program is simultaneously shown, beginning in 1918 with the establishment of the company's employe benefit plan.

After this brief history, the audience is taken on a trip via the movie camera to call upon the 12 annuitants shown in the picture. The activities of these annuitants were remarkable for their diversity, their interest, and the apparent satisfaction afforded.

How They Keep Busy

One of the outstanding case histories is that of *Waldemar Landry*, 89 years old, former Accounting department employe, who has been in retirement for 20 years. He is still active and is shown as he busies himself with amazingly proficient art work, gardening, and raising chickens, as well as carrying out projects in a carpenter shop in the basement of his home.

Lando Charlton, 64, formerly a wax sweaterman at the refinery, now retired to his farm on the banks of the Comite River, is shown operating his tractor, taking a daily dip in the river, and amusing the neighborhood children by playing the guitar.

John Norton, 67, former refinery machinist foreman, is shown as he collects coins, runs an Esso service station, and takes a flight in his son's airplane.

Abe Nesom, 79, chose storekeeping and the film shows him busy in his small neighborhood grocery, where friends come in for an old style cracker-barrel session. Nesom worked as a process employe for 30 years.

Miss Mary Pirie, formerly a secretary, runs a large farm near Denham Springs, La., where she is kept busy with her young nephews and nieces and with her many pets. (She has no less than 13 cats!) The beautiful setting of the Pirie farm drew much admiration from those viewing the picture.

Earl Turner, 67, who turned from oil packaging at the refinery to oil painting, has produced some valuable works of art in bas-relief. He and Mrs. Turner are shown in the process of manufacturing artistic trays by the acid-etching process.

Joe Wileman, 67, former first-class electrician, has carried out a long-cherished dream of having a neighborhood repair shop, where he converts antique vases into lamp stands, makes electrical repairs, and converts treadle-type sewing machines to electric drives. Wileman is also a licensed locksmith.

Activities of other annuitants shown include Jeddie Thompson, former laborer, as he runs his farm; Robert Davis, retired leaderman, as he helps build a church and indulges in his hobby of fishing; Adolph Wiggins, former cooper, who plays the role of storekeeper and landlord, and works for the Community Chest; Manny Carter, porter at Esso, also a landlord, who gardens for exercise and raises flowers and chickens; Jim Bradford, retired mason, who does mason work as a hobby, and who also is supervisor of a Bible school. The scenes of Jim with the young members of his congregation are unusual and striking.

The film ends on the narrator's statement that "A happy retirement is possible for all Esso employes. Whatever your choice may be, you may be assured that the company, Esso Standard Oil, wishes you well as you reap the harvest of the years with Esso!"

Employe Reactions

Employe acceptance has been helped by the fact that the preparation for retirement program is completely visual-aided by means of charts. Another feature is the "handouts" that are distributed at each session. These handouts include a duplication of all of the charts used in that session and related background information that the conferee can read at his leisure. In addition to the movie described, other features of the program that seem to impress the participants include:

1) Each participant is given a loose-leaf binder, embossed with his own name, which is used to hold each session's handouts.

2) Presentation to each member by the vice president and general manager at the last meeting a copy of the book *How to Retire and Enjoy It* inscribed with his best wishes and autograph.

3) Apparent continued interest by the company in those retiring. One said: "Before I went through the pre-retirement program, I looked upon retirement as severing my intimate ties with my company friends and with the company itself. Through this program the company has proved to me that it is still interested in what I do in my retirement period."

In general, the attitude of the prospective annuitants to the program was very favorable. They appreciated it as a company effort in their behalf and as an expression of continuing interest. They learned to look upon retirement in a new light—to view it not as a penalty or something forced upon them, but as an opportunity for a new career.

Follow Up and Continuation

In the final session of the pre-retirement program, the participants are urged to contact the Plant Annuities and Benefits department on any questions or assistance they might need in working out their retirement plans. Plans formulated in the final session of the program are noted, and a follow-up interview scheduled with each individual about a month before retirement.

It is planned to offer the five-hour pre-retirement program to all prospective Esso annuitants. The first group consisted of men who were retired within the next few weeks, but the second group went down the list to men whose retirement was several months away. The personnel of the fourth group consisted largely of employes to whom retirement was over a year away. Immediate plans are to continue the program for the rest of the year on the basis of handling one group of approximately 15 employes every five weeks. In this way employes now 63 years of age will receive this training during the current year. Then, consideration will be given to continuing the program so that employes will get the benefit of the course four or five years before retirement, thus insuring that they will have adequate time to put into effect the principles of planning advocated in the discussions.

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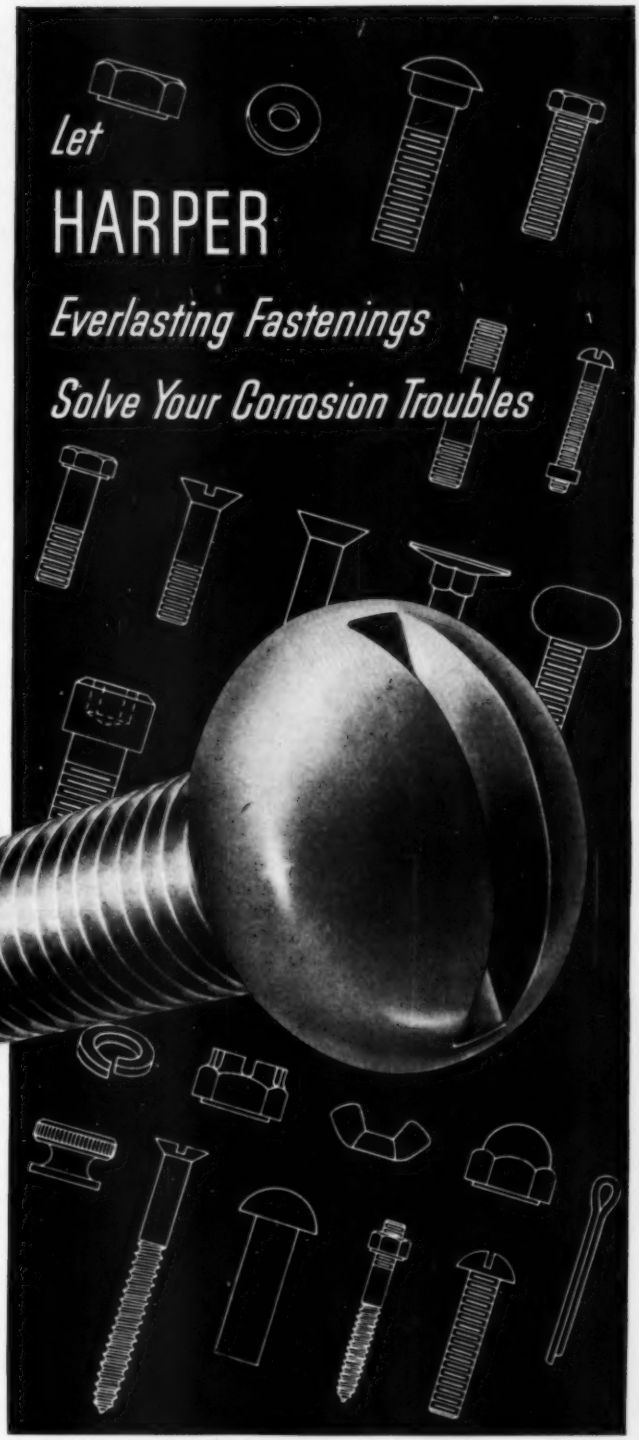

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News Notes on Refinery and Other Plant Construction

Petroleum Refiner's quarterly "Box Score" feature starts on page 80 of this issue

Oil's Capital Expenditure Hits High Total for 1952

The American oil industry is spending more money this year than in any other one-year period in history, according to Frank M. Porter, president of the American Petroleum Institute who reported that a survey indicates that capital expenditures scheduled for 1952 will exceed $4 billion. This estimated expenditure boosts the industry's total for the seven post-war years to more than $19 billion.

The 1952 total represents an increase of 25 per cent over last year's peak of $3270 million, Porter said.

These billions include $566 million for building new refineries, new units, and refinery modernization in the U. S. In 1951 this figure was $303 million. Such foreign work will run about $50 million, a 100 percent gain over the 1951 figure.

Fertilizer and chemical plants for 1952 will run $66 million compared with $25 million in 1951. Natural gasoline and cycling plants are down for $82 million in construction work this year. This is $30 million more than in 1951.

"The immensity of the expenditure scheduled for the year emphasizes the staggering financial requirements of the industry," Porter said. "The ability of oil companies to meet these demands is a graphic illustration of what free capital and free enterprize can do when they are left alone."

M. W. Kellogg, Costain-Brown Firms To Build AIOC Plant

The main contractors for the construction of the new 62,000 barrel-per-day Anglo Iranian Oil Company refinery to be built at Kwinana on Cockburn Sound near Fremantle, Western Australia, will be a consortium of The M. W. Kellogg Company and Costain-John Brown Ltd. The construction of the refinery will be supervised on behalf of the company, by C.H.E. Rebbeck, resident engineer.

Sunray Subsidiary To Build New Corpus Christi Refinery

Detailed plans have been announced for the construction and operation of a proposed $15-million oil refinery to be built near Corpus Christi, Texas, for Suntide Refining Company, newly organized subsidiary of Sunray Oil Corporation. The refinery will have a capacity of 25,000 barrels daily. It is scheduled for completion in the late summer of 1953.

AIOC's Antwerp Refinery Operating Above Design Rate

Anglo-Iranian's new Antwerp refinery, designed to process 1,400,000 tons of crude oil annually, already has operated at a yearly rate of two million tons, an increase from 28,000 barrels per day to 40,000. Company spokesmen have also disclosed that a catalytic cracking plant will be installed at Antwerp. It presently uses a thermal cracking process.

Although officially opened only recently, the plant has been in operation since October. Jointly owned by Anglo-Iranian and the Belgian Petrofina, it was built to help make good the loss of Abadan.

Eight-Million-Barrel Daily Capacity for Crude Topping

If and when facilities which PAD already has recommended for rapid tax write-off are built, U. S. crude-topping capacity will increase 1,289,492 barrels daily and catalytic cracking capacity 922,795 barrels per day, PAD revealed in a breakdown of refining statistics released earlier.

These expansions would lift the total crude topping capacity from 6,814,684 barrels per day as of January 1, 1951, to 8,104,176 barrels daily capacity when facilities are completed. Catalytic cracking capacity would rise from a January 1 figure of 1,933,430 barrels per day to 2,856,225. PAD said its processing of rapid tax write-off applications has been resumed after a virtual halt during May because of oil strikes. It also re-affirmed that it is still accepting applications for additional projects since the 18-month program needs have not yet been filled.

Caltex Philippine Refinery Still Under Negotiation

Caltex (Philippines) Inc., officials in Manila say that negotiations for the site of their proposed $30 million refinery are continuing. Other features of the huge project are currently under discussion with Philippine government officials. The company is optimistic over chances of beginning construction in the near future.

Apart from existing and future investments in marketing facilities for distribution in the Philippines, begun by Caltex over 30 years ago, the present studies involve refinery expenditures in the range of $30 million.

This would provide for a daily crude oil capacity of 13,000 barrels, company officials declared.

Indiana Standard Options Site for Proposed Refinery

Standard Oil Company (Indiana) has taken options on about 900 acres of land at Mandan, N. D., as a site for a new 15,000-barrel-a-day oil refinery currently under consideration. The tracts announced as under option are located about three-quarters of a mile north of the Mandan city limits, west of the Missouri River. They are partially bordered on the east by the Northern Pacific railroad right-of-way and on the west by a county road.

Initial capacity of the projected refinery is planned for 15,000 barrels a day. The design will be such, however, that it can be expanded to run at least 30,000 barrels per day. The plant will include facilities for crude oil distillation, catalytic cracking, vapor recovery, finishing, and shipping. Engineering work is now in progress to establish the design details. At the outset, the principal products made at the refinery will be White Crown and Red Crown gasolines, heater oil, furnace oil and industrial fuel oil. "If the crude situation in the Williston Basin develops as anticipated," company officials say, "construction will begin early in 1953."

Ground Breaking Ceremonies Held For Sun Arosorb Plant

Ground breaking ceremonies were held recently at Marcus Hook, Pa., for Sun Oil Company's petrochemical plant, employing the company's newly-developed Arosorb Process. This plant is one of two in a $12 million project for the production of petrochemicals for defense.

Products of the new Marcus Hook refining plant, combining catalytic reforming and Arosorb units, will include an annual output of 15 million gallons of benzene, 22 million gallons of toluene, and 19 million gallons of xylenes.

The first shovelful of earth was turned by M. Robert Lipkin, who ten years ago was doing basic laboratory research on a new method of separation of chemicals and conceived the idea that it might be used on a large commercial scale.

Expansion Work Underway On Malco's New Mexico Plant

Malco Refineries, Inc., who recently purchased Petroleum Products Producing and Refining Company's 1500-barrel-per-day plant at Prewitt, N. M., has announced that an expansion program designed to boost the plant's capacity to 3000 barrels daily is already underway. The expansion program, which is scheduled for completion in September, will add new cat poly, cat reforming and thermal cracking facilities to those already existing. Construction work on the $500,000 project is being handled by Grebe and Doremus Process Company of Houston.

Shell Opens New Canadian Sulfur Plant in Alberta

Shell Oil Company of Canada has announced the opening of a 30-ton-per-day sulfur plant at Jumping Pound, Alberta, Canada. According to Shell spokesmen, the plant produces 99.9 percent pure sulfur for use by Pacific Coast pulp and paper manufacturers.

Part of an extensive conservation pro-

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gram being conducted by Shell, the plant recovers sulfur from hydrogen sulfide gas that comes with natural gas from wells in the Jumping Pound field.

BM Awards Contract for New Virginia Experiment Station

The Bureau of Mines has awarded a contract for the construction of a $2.6-million experiment station at Morgantown, W. Va., to the Southeastern Construction Company, starting one of the largest construction jobs yet carried out by the Bureau, aside from the synthetic liquid fuels facilities.

Principal activities initially planned for the station include research on the production from coal of synthesis gas, which may be used to produce liquid fuels, ammonia, alcohol and other chemical and headquarters for the Bureau's petroleum and natural gas research in the Appalachian region.

DPA Plans Let-Up in Fast Tax Write-Off Certificates

Defense Production Administration plans a gradual closing down of granting certificates of necessity for rapid tax amortization, started in 1950, as the industrial expansion goals in various industries are reached. In its announcement, DPA stated that no more expansion requiring tax amortization should be planned without prior consultation with government agencies responsible for the particular industry involved. In the case of the petroleum industry, the claimant agency is Petroleum Administration for Defense. See table below.

Petroleum refining expansion goal was established by PAD-industry conferences and the total was originally set at a dollar value of slightly more than $1 billion. As of March 31, the latest date for which complete figures are available, approximately 34 percent of this expansion was in place. (See Petroleum Refiner, May, 1952, page 158.)

Phillips Completes Plans For West Texas Gasoline Plant

Phillips Petroleum Company has completed plans for its new Pembrook natural gasoline plant in the Spraberry Trend of West Texas. The plant will be located 20 miles south of the company's Spraberry plant, now under construction. Pembrook plant will be the approximate size and design of the Spraberry plant. While each plant was originally designed to process 60 million cubic feet of gas daily from Spraberry Trend wells, principally in Midland, Upton, Glasscock, and Reagan counties, expansion of Spraberry plant to a capacity of more than 150 million cubic feet daily is already under way.

Plans also call for extension of the company's products gathering line to the Benedum plant for the Spraberry plant. The first of the new facilities is expected to operate late this year and all others in the early part of 1953.

Construction Underway On Texas City Cat Cracker

Construction has started on a new 19,000-barrel-per-day Houdriflow catalytic cracking unit at the Texas City Refining, Inc., refinery at Texas City, Texas. The unit, which includes a 350-foot cracking tower, will cost an estimated $2,400,000 and is scheduled to be in operation before the end of the year. The Houdriflow unit will be the chief addition in an over-all modernization program made possible by a refinancing arrangement announced by V. A. Fogg, president of the firm.

Average daily crude oil thruput will be 40,000 barrels. The modernization work is expected to add considerably to the amount of high-octane fuel the refinery can produce.

BA Plant To Go On Stream

British American Oil Company, Ltd.'s enlarged and modernized Moose Jaw refinery in Canada is expected to go on stream in early September to supply customers in the Prairie Provinces.

Standard-Vacuum To Increase Capacity of Bombay Refinery

Standard-Vacuum Oil Company has announced that it will increase the size of its proposed Bombay refinery to 25,000 barrels per day capacity. The project, which was announced by the Government of India last November, represents a $35 million investment and was originally scheduled to have a capacity of 19,000 barrels per day.

The increase means that the output of products will rise to 1,210,000 long tons per year, or one-third more than was originally contemplated. The new process designs for the 25,000 barrels-per-day plant anticipate an annual production of nearly 48 million gallons of kerosine, as compared with the original estimate of 33⅓ million gallons.

The company said it now appears that the refinery, which will be located on Trombay Island in Bombay harbor, may be ready for operations several months earlier than the 1956 date first anticipated. The Lummus Company has been awarded the construction contract.

Phillips Plans Expansion Of Texas Gasoline Plant

Phillips Petroleum Company is expanding its Bayou natural Gasoline plant located near Alvin, Texas, to increase the plant's gas handling capacity by approximately 50 percent. The plant began operations in 1951 and is now producing in excess of 200,000 gallons of natural gasoline and liquified petroleum gas daily. The expansion program includes installation of two absorbers and four gas scrubbers and conversion of two compressors to compress raw gas from the Chocolate Bayou field to the plant operating pressure. The expansion program will be completed late this fall.

Five Platformers For AIOC Being Designed By UOP

Universal Oil Products said recently it has started engineering and design work on five Platforming units for An-

Rapid Tax Amortization Certicates Granted by DPA May 2 to June 5

COMPANY AND LOCATION	Type of Facility	Amount Amortization Certified	Percent Allowed
Gulf Oil Corp., Philadelphia	Propane-Propylene	229,393	65
Sun Oil Co., Marcus Hook, Pa.	Lubricants	99,200	65
The Pennzoil Co., Rouseville, Pa.	Lubricating Oil	168,068	15
		985,284	65
Northwestern Refining Co., St. Paul Park, Minn.	Oil Refining	268,000	45
		2,225,000	65
Gulf Oil Corp., Deer Park—Port Arthur, Tex.	Ethylene	585,800	60
Rado Refining Co., McAllen, Texas	Gasoline	451,900	65
		288,000	40
		1,581,461	35
Phillips Petroleum Co., Borger, Texas	Natural Gasoline	1,323,000	65
		1,035,000	50
		412,000	40
Cabot Carbon Co., St. Mary Parish, La.	Carbon Black	1,847,080	50
Cabot Carbon Co., Centerville, La.	Carbon Black	1,097,475	50
Continental Carbon Co., Sunray, Tex.	Carbon Black	185,000	50
United Carbon Co., Inc., St. Mary Parish, La.	Carbon Black	2,655,500	50
Rado Refining Co., McAllen, Texas	Motor Fuel	1,880,000	65
		625,000	45
		75,000	15
Thermatomic Carbon Co., Sterlington, La.	Thermal Carbon Black	198,500	80
Phillips Petroleum Co., Borger, Texas	Gasoline	570,300	90
		198,300	50
		372,437	40
		25,500	15
Phillips Chemical Co., Borger, Texas	Carbon Black	479,560	50
Phillips Chemical Co., Borger, Texas	Carbon Black	2,395,900	50
United Carbon Co., Inc., Wheeler, Texas	Carbon Black	1,907,500	50
Thermatomic Carbon Co., Sterlington, La.	Carbon Black	985,110	50
Southwest Gas Producing Co., Inc., Dubach, La.	Gasoline	1,690,900	90
		2,080,700	65
		188,500	40
Humble Oil & Refining Co., Baytown, Texas	Petroleum Products	595,000	50
		355,000	35
Continental Oil Co., Ponca City, Okla.	Lube Oil Detergent and Inhibitor	362,310	65
		388,942	50
		328,219	40
		645,640	15
Continental Oil Co., Ponca City, Okla.	Gasoline	215,000	40
		3,335,000	30
Stanolind Oil & Gas Co. (North Cowden Plant, Midland, Texas	Sulfur	202,000	70
Shell Chemical Co., Houston, Texas	Epon Resins	4,063,000	50
		472,900	45
		226,100	15
American Petro-Chemical Corp., Lake Charles, La.	Vinyl and Ethyl Chloride	26,640,000	50
Pan-Am Southern Corp., Destrehan, La.	Gasoline	2,332,000	65
		418,500	50
Continental Carbon Co., Hobbs, N. Mex.	Carbon Black	1,010,500	50
Standard Oil Co. of California, Richmond, Calif.	Petroleum Products	1,001,600	50
		18,400	15
Shell Oil Co., Martinez, Calif.	Motor Gasoline	242,000	65
Union Oil Co. of California, Wilmington, Calif.	Motor Polymer	1,512,000	65
		488,000	40
Douglas Oil Co. of California, Paramount, Calif.	Gasoline	203,991	65
		128,592	45
		33,000	40
Tide Water Associated Oil Co., Avon, Calif.	Gasoline	350,000	90
		850,000	65

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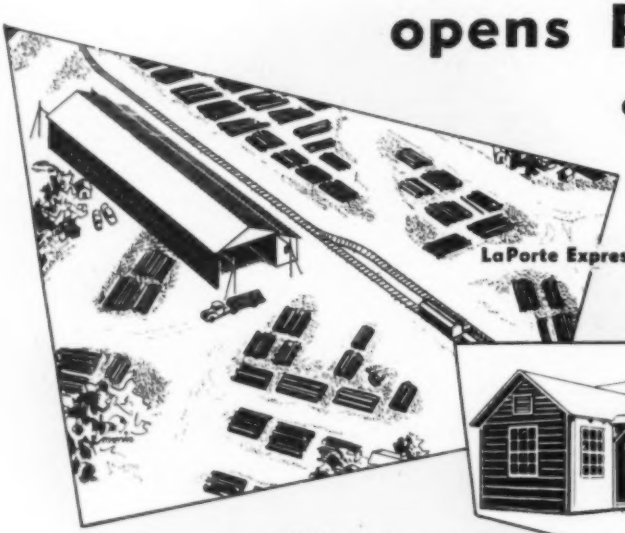
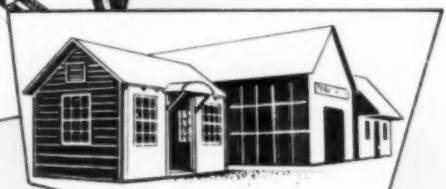


LaPorte Expressway at the Old Galveston Highway



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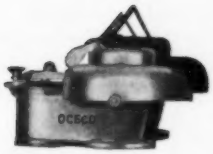

V-113 VENT VALVES control tank breathing, minimizing vapor losses and deterioration of product. High flow capacity. 2" to 12" sizes. ½ oz. to 8 oz. pressure or vacuum settings.

GAUGE HATCHES provide a gas tight closure for gauging, sampling and taking temperature readings. Pedal type hatch opens with a natural straight downward foot movement. Flanged or screw mounting. Also clamping cover type for pressures from 2 oz. to 15 lbs.

V-114 INTERNAL TANK VALVES are provided with a fusible link that melts when subjected to fire, closing the valve instantly, and cutting off the flow from the tank. 3", 4", 6", 8" and 10" sizes.

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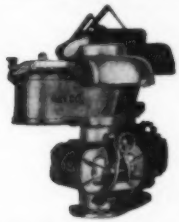
TYPE "E" FLAME ARRESTORS can withstand long exposure to fire. The "banks" have vertical straight through passages—minimizing entrainment and pressure drop, and are "extensible" for easy cleaning. 2" to 10" sizes.



TYPE "BE" VENT UNITS consist of a V-113 Vent Valve with snuffer, mounted on a Type "E" "Extensible" Bank Flame Arrestor. 2" to 10" sizes. Unsurpassed for efficiency and reliability.

WATER DRAW-OFF VALVES for drawing water from the bottom of storage tanks. Unique double valve construction permits the valve chamber to be drained to prevent freezing, and the working valve serviced without emptying tank. 2" x 1½"; 3" x 2" and 4" x 3" sizes.

● Oceco Vents eliminate the free discharge of vaporized liquids. They control tank breathing resulting from temperature changes and pumping – protect the quality of the stored product – and prevent "blow-outs" and "cave-ins". Oceco Flame Arrestors are a positive flame stop – they prevent explosions and fires.

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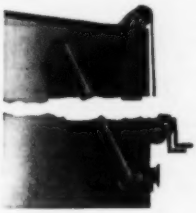
A few of the most popular Oceco fittings are illustrated and described briefly herewith. But send for the Oceco Data Sheets. They give full details and specifications, and complete listings of sizes, weights, dimensions, etc. Let the Oceco Engineers – pioneers in this work – help you equip your tanks for utmost safety and economy.

V-108 EMERGENCY PRESSURE RELIEF VENTS provide instant relief for excessive internal pressures, resulting from exposure fires, etc. Furnished in 6", 8", 10", 15¼" and 20½" sizes.



SWING LINE EQUIPMENT – complete facilities including heavy duty tank nozzle; efficient double elbow swing joint; swing pipe; cable clamp; cable; sheave bracket and internal or external winch.

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glo-Iranian Oil Company. Four units will have a design capacity of 6000 barrels per day each and the fifth, 12,000 barrels daily. Two units are intended for United Kingdom refineries, and the others for plants in France, Aden area and Australia.

American Petrochemical Gets Government OK On New Plant

American Petrochemical Corporation, jointly owned by Cities Service and Firestone Tire and Rubber Company, recently received a certificate of necessity from the Federal Government for construction of a large petrochemical plant at a site on the Gulf coast yet to be selected. Engineering plans have been underway for several months and are near completion. The plant's production will ultimately encompass the fields of plastics, synthetic rubber, anti-freeze and many high volume petrochemicals.

PAD Says Nation Needs More Basic Refining Capacity

More basic refining capacity still is needed to meet expansion goals, the Petroleum Administration for Defense emphasized recently. Also, the program calling for 500,000 tons of sulfur a year from petroleum is 15 percent short and expansion of facilities for high viscosity lube oil production has been "disappointing," PAD said.

On the oher hand, enough benzene production expansion is underway or planned to meet the goal of 131 million gallons per year and the same is true of facilities for detergent-type lube oil additives, where the goal is 10-million pounds per month capacity.

AIOC Annual Report Tells of Refinery Expansion Plans

According to Anglo-Iranian Oil Company's annual report issued recently, the Abadan refinery shut-down resulted in AIOC's total refinery thruput declining from 650,000 barrels per day in 1950 to 480,000 in 1951. Abadan processed 91.5 million barrels of crude in 1951 prior to the July shutdown as compared with 180 million barrels in all of 1950. AIOC said expansion of the company's refining operations in other countries helped to offset this loss of products.

The company plans to expand refining capacity in 1952 in Great Britain, France, Italy, Belgium and Germany by 117,000 barrels per day and 62,000 barrels daily new capacity in Australia.

Oil Industry Expanding But Supplies Tight, Warren Says

PAD's new deputy, J. Ed Warren, advised recently that satisfactory progress is being made in expansion of oil facilities but, at the same time, pointed to possible headaches on the supply side of the picture. Warren's first address as deputy PAD was made to a meeting of the Pennsylvania Grade Crude Oil Association in Pittsburgh.

On the supply side, Warren made two principal points:

Despite the fact that capacity for producing aviation gasoline has been more than doubled in the past 18 months, the demand has been keeping pace and any interruptions in output, such as labor strikes, have serious and immediate consequences. Loss of about 2.5 million barrels of avgas from the strike dramatizes the imperative need for increasing aikylate production.

An "even more all-embracing problem" is that the nation has a very small margin of safety on refining in general.

Certificate Of Necessity Granted Jefferson Plant

Jefferson Chemical Company, Inc., has announced that it has been granted a certificate of necessity for construction of facilities at its Port Neches, Texas, plant to manufacture ethylene oxide and ethylene glycol via the direct oxidation of ethylene.

As presently planned, the new facilities would consist of an additional feed gas line from The Texas Company's Port Arthur works, an ethylene cracking and fractionating unit, an ethylene oxide unit and an ethylene glycol unit.

According to a recent Defense Production Administration release, sufficient applications for rapid tax amortization on new production facilities for these chemicals have already been submitted to insure attainment of expansion goals to January 1, 1955. These forecasts cover both military and civilian market growth as presently envisioned.

Union Oil's New Wilmington Cat Cracker in Operation

Union Oil Company's new $9-million fluid catalytic cracking unit with 28,500 barrels per day charge capacity went on stream recently at Wilmington, Calif., increasing cracking capacity to 58,500 barrels daily. The refinerv's crude thruput remains at 70,000 barrels per day.

Australian Cabinet Approves Proposed Caltex Refinery

The New South Wales state cabinet has approved in principle the establishment of an oil refinery by Caltex Oil Proprietary, Ltd., at Kurnell, Botany Bay. Prime Minister John Cahill said the company proposed building a $55,-812,500 industry there and hoped the refinery would be operating in two years.

Refinery and Other Plant Construction

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
EAST									
Allied Chemical	Hopewell, Va.	Synthetic Nitrogen	†50,000 tons yr.	$12.5 million					
Allied Chem. & Dye	N. Claymont, Del.	Chem. plt.		$3.5 million	Under Constr.	1952			
Allied Chem. & Dye	Buffalo, N.Y.	Aromatics Fac.		$6,940,000	PAD Certified				
Ashland O&R	Catlettsburg, Ky.	Refinery Exp.	†5,000 bbls.		Under Constr.	Sept., 1952	Houdry	Ashland & Catalytic	Catalytic
Ashland O&R	Louisville, Ky.	Gasoline Exp.		$2 million	Certified DPA				
Ashland O&R	Buffalo, N.Y.	Expansion		$3.5 million	Under Constr.	1952	UOP	Catalytic	Catalytic
*Ashland O&R	Tonawanda, N.Y.	Revamp Fac.			Under Constr.	End, 1952		Catalytic	Catalytic
Atlantic Refining Co.	Philadelphia, Pa.	Detergent Mfg. Facilities		$1.5 million	Under Constr.			Atlantic	Ferguson
Atlantic Refining Co.	Philadelphia, Pa.	Catalytic Reforming Unit	11,000 bbls.	$4 million	Under Constr.	Mid 1952	Atlantic	Badger Div.	Badger Div
Atlantic Refining	Philadelphia, Pa.	Two stage pipe still, Cat; Alky; Poly Units	50,000 bbl.	$5.6 million	Under Constr.	1952			Badger Div.
Atlantic Refining	Philadelphia, Pa.	Sulfuric Acid Plt.	3,500 bbls.	$3,214,000	Under Constr.	1953		Kellogg	Kellogg
Atlantic Refining	Philadelphia, Pa.	Orthoflow Cat. Cracking	45,000 bbls.		Spring Constr.	1953		Kellogg	Kellogg
Atlantic Refining	Philadelphia, Pa.	Syn. Ammonia Plt.	100 tons		Contracted				Hydrocarbon
California Refining	Barber, N. J.	Expansion	47,000 bbls.		Under Constr.	1952			
Cambridge Gas Light Co.	Cambridge, Mass.	Light Oil Recov.	24 mmcf		Contracted			Blaw-Knox	Blaw-Knox
Coastal Oil	Pt. Newark, N.J.	Storage Fac.		$275,000	PAD Certified				
Davison Chemical	Baltimore, Md.	Catalyst Mfg. Plt.		$210,494	Certified DPA				
Delta Refining	Memphis, Tenn.	Airlift Cat. Crk.	3,000 bbls.	$1.8 million	Under Constr.	Late 1952	Socony Vac.	Koch	Koch
Delta Refining	Memphis, Tenn.	Cat. Poly; gas cone; crude distillation revamp	†2,000 bbls.		Under Constr.	Late 1952		Koch	Koch
Dewey & Almy Chemical Co.	Cambridge, Mass.	Synthetic Rubber Addition		$404,000					
Du Pont	Deepwater Point, N. J.	Tetraethyl Lead Fac.	140,000 lbs.	$3.4 million	Under Constr.	1952			
*Elk Refinery Co.	Falling Rock, W. Va.	Platformer	1,500 bbls.	$950,000	Under Constr.	Aug., 1952	UOP	Procon	Procon

* Continued on page 83

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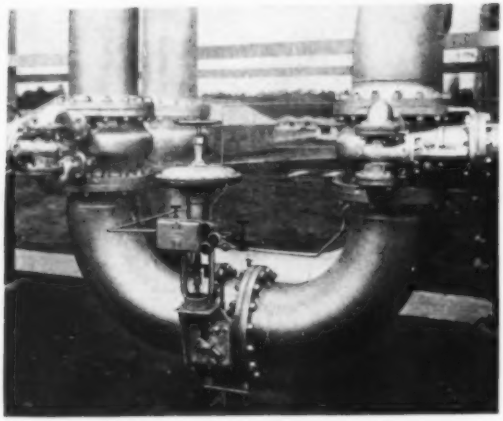

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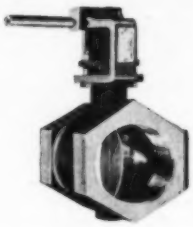
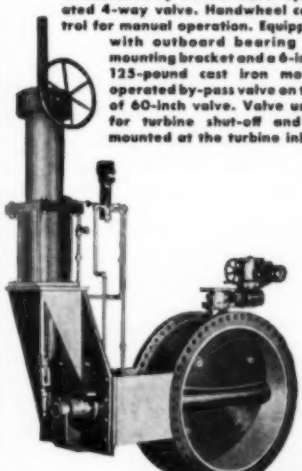
No. 836—24-inch 125-pound cast iron hub-end valve with bronze liner and monel periphery on vane for water service. Equipped with totally enclosed gear reducer, handwheel and locking device.



No. 801—3-inch 125-pound bronze screwed-end valve with handlever control and locking device.

No. 828—60-inch 150-pound cast steel valve with 18-8 shafts, bronze bushings and bronze body liner. Cylinder operator is controlled by electric motor operated 4-way valve. Handwheel control for manual operation. Equipped with outboard bearing on mounting bracket and a 6-inch 125-pound cast iron motor operated by-pass valve on top of 60-inch valve. Valve used for turbine shut-off and is mounted at the turbine inlet.



REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Esso Petroleum	Everett, Mass.	Expansion-crude	†9,500 bbls.		Completed	June, 1952			Foster Wheeler
Esso Standard	Bayonne, N. J.	Crude Dist.	20,000 bbls.		Under Constr.	Late 1952		Lummus, SOD & Foster Wheeler	Lummus, SOD & Foster Wheeler
		Atmos Pipe Still	28,500 bbls.						
Esso Standard	Bayway, N.J.	Refinery Prod. Exp.			Completed				
Esso Standard	Everett, Mass.	Expanded Gasoline Fac.			Under Constr.	1953			
Esso	Everett, Mass.	Fluid Cat. Crk.	†18,500 bbl.		Under Constr.	Early 1953		SOD	Foster Wheeler
Esso	Everett, Mass.	Rerun pipe still	†7,000 bbl.		Under Constr.	3rd Qtr., 1952		SOD	
Ethyl	Edgemor, Del.	Tetraethyl Lead		$184,125	PAD Certified				
*Frankes Oil Refining	Tonawanda,N.Y.	Refinery Exp.	†8,000 bbls.	$6 Million	Announced				
Frontier Oil Ref	Erie City, N. Y.	Basic Ref. & Alkylation		$1.1 million	PAD Certified				
Geon (Goodrich)	Calvert City, Ky.	Petro chem. Plt.			Under Constr.	Late 1952			
Gulf Oil	Harmarville, Pa.	Research Lab.		$1.1 million	Completed	June, 1952		Gulf	Seaman
Gulf	Philadelphia	Crude; Atome. & Vacuum Unit	125,000 bbls.		Under Constr.	Summer 1953		Foster Wheeler	Foster Wheeler
Gulf	Philadelphia	Gasoline Sweetening	40,000 bbls.		Designing	Summer 1953		Gulf	
Gulf	Philadelphia	Cat. Reform.	10,000 bbls.		Designing	Summer 1953			
Gulf	Philadelphia	Cat. Cracker	63,000 bbls.		Designing	Summer 1953		Kellogg	Kellogg
Hercules Powder	Gibbstown, N. J.	Petrochemicals (Phenol)		$8 million	Start Late 1952	1953			
Koppers	Kobuta, Pa.	Styrene Monomer		$4 million	Under Constr.	Sept., 1952		Koppers	Koppers
Mathieson Hydrocarbon Chemical Corp.	Brandenburg, Ky.	Chemical Plt.		$17 million	Under Constr.			Badger Div.	Badger Div.
M. F. A. Oil	Memphis, Tenn.	Cat. Crk. & Aux.	2,200 bbl.	$1.7 million	Under Constr.	Dec., 1952	So-Vac	Koch	Koch
Monsanto	Charleston, W. Va.	Enlarg. Chem. Facilities		$9 million	Engineering	Spring, 1952			
Monsanto	Springfield, Mass.	Polyvinyl chloride resin		$1.2 million	Announced				
Sinclair Ref.	Marcus Hook, Pa.	Sulfur Extraction	20 tons	$320,000	Under Constr.	Oct., 1952		Parsons	Parsons
Socony-Vacuum	Paulsboro, N.J.	Expansion	46,000 bbl.	$12-15 m illion	Under Constr.	3rd Qtr., 1952		Staff-Braun	Braun
Socony Vacuum	Paulsboro, N.J.	TCC Unit	15,000 bbls.			3rd Qtr., 1952		Staff-Fluor	Fluor
Socony-Vacuum	Paulsboro, N.J.	Products Exp.			Announced				
Socony-Vacuum	Paulsboro, N.J.	Bead Catalyst Mfg.		$4 million	Certified DPA				
Sun Oil	Marcus Hook, Pa.	Lube Oil Plt.	8,400 bbls.	$2.5 million	Under Constr.	April, 1952		Sun	Sun
Sun Oil	Marcus Hook, Pa.	Arcomber and Houdriformer	10,000 bbls.	$8.4 million	Engineering	Fall 1952	Sun-Houdry	Texro	Sun
*Sun Oil Company	Marcus Hook, Pa.	Aromatics Plt.		$12 Million	Design			Kuljian	
*Texas Company	Westville, N.J.	Crude Desalt.	60,000 bbls.		Under Constr.	Early, 1953		Texas Co.	
Union Carbide and Carbon Co.	Institute, W. Va.	Coal Hydrogenation Pilot Plt.	300 tons coal	$11 million	Complete				
United Refining Co.	Warren, Pa.	Lab.			Under Constr.				
U. S. Industrial Chemical	Baltimore, Md.	Ethyl Alcohol Plt.		$328,815	Announced				
MID-CONTINENT									
Allied Chemical & Dye Corp.	South Point, O.	Synthetic Nitrogen	50,000 tons yr.	$12.5 million	Design				
American Cyanamid	Michigan City, Ind.	Synthetic Cat. Prod.	To 400 tons	$5 million	Complete	June, 1952		Blaw-Knox	Blaw-Knox
Ashland Oil & Ref.	Canton, Ohio	Fluid Cat. Crk.	8,000 bbls.	$4 million	Complete		U.O.P.	U.O.P.	McKee
Ashland	Canton	Cat. Poly Unit	600 bbls.		Complete		U.O.P.	U.O.P.	McKee
Ashland	Canton	Add. Crude	20,000 bbls.		Complete			U.O.P.	McKee
		Topping	†7,500 bbls.		Complete			U.O.P.	McKee
*Ashland O&R	Catlettsburg, Ky.	Vacuum Unit	$11,000 bbls.		Field Work			Catalytic	Catalytic
		Crude Tower	†7,000 bbls.		Field Work			Catalytic	Catalytic
		Kerosine Treat. Unit	10,000 bbls.		Completed			Catalytic	Catalytic
Ashland O&R	Findlay, Ohio	Gasoline Mfg.		$2.6 million	Under Constr.	Fall, 1952			
Aurora Gasoline	Detroit, Mich.	Basic Refining		$400,000	Announced				
Ben Franklin Refining	Ardmore, Okla.	Expansion	†4,500 bbls.	$2 million	Under Constr.				
Bureau of Mines	Otis, Kans.	Reopen Heli. Plt	48 Mcf/yr.	*$3 million	Under Constr.				
Cities Service Oil Co.	Chicago, Ill.	Grease Making Fac.	8.5 million lbs.		Planned				
Cities Service	E. Chicago, Ind	Fluid Hydroformer	10,000 bbls.		Design	Late, 1952		Kellogg	Kellogg
Cities Service	Blackwell, Okla.	Nat. Gasoline Plt.	4,900 bbls.	$4 Million	PAD Certified	Early 1953			
Consumers Coop	Philipsburg, Kans.	Cat. Crk. Unit	5,000 bbls.	$2.6 million	Under Constr.	Feb., 1953	U.O.P.	Ref. Eng.	Ref. Eng.
		Dist. Expansion	†4,000 bbls.		Under Constr.	Mid 1953		Ref. Eng.	Ref. Eng.
Continental Oil	Ponca City, Okla.	Expansion	None	$7.5 million	Start Spring	Mid 1953	Continental	Staff	Staff
Deep Rock Oil	Cushing, Okla.	Aromatics Fac.		$3,250,000	PAD Certified				
Deep Rock Oil	Cushing, Okla.	Lube Oil Plt.	1,050 bbls.	$2 Million	Engineer	Mar., 1953	JUIK	Kellogg	Kellogg
Deep Rock Oil	Cushing, Okla.	Lube Oil Expan.		$350,000	Complete			Blaw-Knox	Blaw-Know
Derby Oil Co.	Wichita, Kans	TCC Cat Poly Gas Concent.		$2 million	Complete		Socony Vac., U.O.P.	Fluor	Fluor
Detroit Chem. Wks.	Detroit, Mich.	Sulfuric Acid		$950,000	PAD Certified				
Dow Chemical	Midland, Mich.	2nd Hypersorption Unit			Under Constr.		Union Oil (Calif.)	Foster Wheeler	Foster Wheeler
Dow Chemical	Ludington, Mich.	Bromine for TEL	2 million lbs. yr.	$433,500	Under Constr.				
Dow Chemical	Midland, Mich.	Ethylene Dibromide		$370,000	Under Constr.				
Dow Chemical	Midland, Mich.	Vinyltoluene Plt.		$8 million	Constr. Fall	July, 1952		Stone & Webster	Stone & Webster
Dow-Corning	Midland, Mich.	Methyl Chloride		$820,000	Under Constr.	Sept., 1952		Staff	Staff
El Dorado Refining	El Dorado,Kans.	Expansion	†4,000 bbls.	$3 million	Under Constr.			Ref. Eng.	Ref. Eng.
Great Northern	St. Paul, Minn.	Crude Topping	30,000 bbls.						
Great Northern Oil	St. Paul	Cat. Crk.	7,520 bbls.	$26 million	Certified DPA				
Great Northern	St. Paul	Cat. Reformer	6,000 bbls.						
Great Northern	St. Paul	Cat. Poly.	680 bbls.						
Gulf Oil	Cincinnati, Ohio	Canning Plt.			Announced				
International Refineries	Carlton City, Minn.	Refinery	11,500 bbls.	$7 million	Under Constr.	Oct., 1952	S.O.D.	Lummus	Lummus
Kanotex Refining	Arkansas City, Kans.	Vacuum Unit	4,600 bbl.	$2.4 million	Under Constr.	June, 1952	U.O.P.	U.O.P.-Ref.Eng	Ref. Eng
Kanotex	Arkansas City	Fluid Cat.	5,700 bbl.						
Lakeside Refining	Kalamazoo, Mich.	Cat. Reformer	1,300 bbls.	$200,000	Under Constr.	Oct., 1952	Phillips	Koch	Staff

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Leonard Refineries	Alma, Mich.	Expand. Crk. Capacity	†4,000 bbls.					Cat. Constr.	Cat. Constr.
Lion Oil	El Dorado, Ark.	Av-Gas Expan.	432 bbl.	$810,000	Under Constr.				
Lion Oil	El Dorado, Ark.	Cat. Crk. Unit	5,000 bbls.	$5 million	Announced	Late 1953			
Lion Oil	El Dorado, Ark.	Alkylation Plt.	1,150 bbls.					Fluor	Fluor
Mathieson Chem.	McKamie, Ark.	Sulfur Extrac.		$198,990	Contracted			Ref. Eng.	Ref. Eng.
Merreury Oil Refining	Oklahoma City	Cat. Crk.; Poly.	2,500/360 bbl.	$3.2 million	Design	Late 1952			
Mercury	Oklahoma City	Topping; Thermal	5,900/1,800 bbl.						
Michigan Chem.	St. Louis, Mo.	Sulfuric Acid		$81,681	PAD Certified				
Mid-Continent Petroleum	Tulsa Co., Okla.	Aviation Gaso. Fac.		$119,572	Certified DPA				
Midland Coop. Wholesale	Cushing, Okla.	Capacity Exp.	†4,000 bbls.	$3 Million	Engineering Studies	May, 1953	U.O.P.	U.O.P. & Ref. Engineers	Refinery Engineers
Minnesota Mining	Copley Twp., Ohio	Sulfuric Acid Fac.		$2.1 million	Under Constr.				
Monsanto Chemical	Addyston, Ohio	Styrene Plastics Plt.			Plan				
Natl. Petro Chemicals Corp.	Tuscola, Ill.	Ethane-Propane Nat. Gas		$32 million	Announced	Late 1952			
Natl. Petro Chem.	Tuscola, Ill.	Petro Chem Plt.	500 mmcf	$32 million	Under Constr.	Late 1952			Vulcan, Pritchard, Foster Wheeler, Lummus
Northern Nat. Gas	Holcomb, Kans.	Gas Dehydration Plt. Addi.			Under Constr.	Jan., 1952		Dresser	Dresser
Northern Nat. Gas	Holcomb	Gas Rcfg. Plt.	185,000 mcfd		Under Constr.	Jan., 1952		Dresser	Dresser
Northwestern Refining	St. Paul Park, Minn.	Topping & Cracking Unit	30,000 bbl.	$2 million	Under Constr.	Aug., 1953		U.O.P.	Procon
Ohio Oil	Robinson, Ill.	Coking Unit	5,000 bbls.		Under Constr.	April, 1953			Lummus
Ohio Standard	Cleveland, O.	Crude Topping	7,.00 bbl.	$4.2 million	Design				
Oklahoma Refg. Co.	Cleveland Seminole, Okla.	Cracker; Poly Refinery	18,000/40 bbl. 200 bbls	$40,000					
Old Dutch Refining	Muskegon, Mich.	Aromatic Fac.	150 B 370 T.	$515,130	Under Constr.				Parker
Pana Refining	Pana, Ill.	Girbotol Unit	900 bbl.	$700,000	Under Constr. Completed		U.O.P.	U.O.P.	
Petroleum Spec.	Flat Rock, Mich	Cat. Reformer	3,000 bbls.	$2 million	Planning				
Petroleum Specialties	Flat Rock, Mich	Cat. Cracker		$4.5 million	Under Constr.	May, 1952		Fluor	Fluor
Phillips Petroleum Co.	Okmulgee, Okla	Cat. Crk. with Feed Prep. Unit & Gas Plt.						Fluor	Fluor
Phillips Petroleum	Okmulgee, Okla	Cgr. Crk: Others	†8,000 bbls.	$390,000	Complete				
Pure Oil	Smiths Bluff, Ark	Alkylate Fac.		$2.5 million	Under Constr.				
Pure Oil	Toledo, Ohio	Alkylation Unit (Sulfuric Acid)			DPA Ok'd				
Pure Oil	Toledo, Ohio	Modernization	30,000 bbls.		Planning				
Pure Oil	Toledo, Ohio	Orthoflow Cat.	15,000 bbls.		Start May	Spring 1953		Kellogg	Kellogg
Roosevelt Oil & Refining	Mt. Pleasant, Mich.	Benzene Plt. and Auxiliary	1,140 bbls.	$1.5 million	Start May	Spring 1953		Kellogg	Kellogg
Roosevelt O&R	Mt. Pleasant, Mich.	Platformer	1,750 bbls.		Under Constr.	Sept., 1952	U.O.P.	U.O.P.	Procon
Roosevelt O&R	Mt. Pleasant, Mich.	Udex Upit	1,200 bbls.	$1.5 Million	Under Constr.	Sept., 1952	U.O.P.	U.O.P.	Procon
Shallow Water Refining	Scott Co., Kans.	Gasoline Mfg.			Complete			U.O.P.	Procon
Shell Oil	Wood River, Ill.	Expansion and Improvement	†50,000	$42.5 million	Under Constr.	Late 1953		Staff	Staff
Sinclair Refining	E. Chicago, Ind.	Refinery Expan.	20,000 bbl.		Complete			Shell	Foster-Wheeler Fluor
Sinclair Refining	Hartford, Ill.	Gasoline Fac.		$34.4 Million	PAD Certified			McKee	McKee
Sinclair Refining	Hartford, Ill.	Crude Expansion	†37,000 bbls.		PAD Certified	Jan., 1953			
Sinclair Ref.	Wood River, Ill.	Sulfur Extraction Plt.	10,000 bbls.					Badger Div.	Badger Div.
Skelly Oil	Velma, Okla.	Booster Station			Planned				
Socony-Vacuum	E. St. Louis, Ill.	Alky. Unit Rehab.	775 bbls.	$260,000	Design				
Socony-Vacuum	E. Chicago, Ind.	Avgas Facilities		$4 million	Plan				
Standard-Ind.	Neodosha, Kans.	Cat. Crk.; Alky. Unit	9,300 bbl.	$10 million	Under Constr.	End 1952			
Standard-Ind.	Sugar Creek, Mo.	Crude Expan.	†30,000 bbl.	$21 million	Preparing	End 1952			
Standard-Ind.	Sugar Creek	Olefin Concentrate		$142,000	Announced				
Standard-Indiana	Whiting, Indiana	Sulfur Recovery Plt.	55 tons	$1.7 million	Under Constr.	Middle 1952		Fluor	Fluor
*Standard (Ind.)	Wood River, Ill.	Additives Plt			Design	1953		Staff	Staff
Standard-Ind.	Wood River, Ill.	Alcohols Prod.	10 million lbs.	$2.6 million	Design	Mid 1952			
Standard-Indiana	Whiting	Benzene Expan.	1,044 bbls.		Announced	2nd Half 1952			
Standard (Indiana)	Wilkston Basin, N. D.	New Crude Refinery	15,000 bbls.		Projected				
Standard Oil of N.D.	Grand Forks, N. Dakota	Refinery	2,000-2,500 bbls		Planning				
Standard (Ohio)	Cleveland, Ohio	Crd. Dist. Plt.	45,000 bbls.	$6½ million	Under Constr.	Jan., 1952		McKee	McKee
Standard-Ohio	Toledo, Ohio	Alkylation Unit		$3 million	Early 1952	Mid 1953		Sohio Research	
Standard-Ohio	Lima, Ohio	Crude Coking—		$2.4 million	Engineering				
		Cat. Reforming	3,000 bbls.	$8.5 million	Engineering	15 months			
Standard (Ohio)	Lima, Ohio	Alkylation Feed Unit		$12.3 million	Certified DPA				
Standard (Ohio)	Cleveland, Ohio	Alkylation Feed Unit		$6.7 million	Certified DPA				
Stanolind Oil & Gas Co.	Tulsa, Okla.	Research Center			Planning			Shreve, Lamb & Harmon Assoc.	
Stanolind Oil & Gas	Grant Co., Kans.	Isobutane Mfg.		$1 million	Certified DPA				Ref. Eng.
Superior Refinery Owners, Inc	Superior, Wis.	Topping Thermal Crk.; Poly.	6,000 bbl. 1000/24 bbl.	$1.2 million	Completed				
Sun Oil	Toledo, Ohio	Platform Unit	10,000 bbls.		Under Constr.		U.O.P.	Staff	Staff
Sunray Oil	Duncan, Okla.	Alkylation Fac.	2,100 bbl.	$1.7 million	Under Constr.	Aug., 1952	U.O.P.	Foster Wheeler,	Foster Wheeler,
Texas Co	Lawrenceville,Ill.	Expand Refinery	†20,000 bbls.		Under Constr.	1951		Kellogg	Kellogg
Texas Natural Gasoline	Tulsa, Okla.	Gasoline, Propane, Butane			Announced				
The Texas Co.	Lockport, Ill.	Lube Oil Plt.	3485 bbls.	$17.6 million	Certified DPA				
The Texas Co.	Lockport, Ill.	Crude Expan., etc.	†25,000 bbls.	$15 million	Not Certified				
Tide Water Assoc. Oil	Drumright, Okla.	Crude Topping; Vacuum	15,000 bbl. 6,000 bbl.		Design			Ref. Eng.	Ref. Eng.
Vickers Petroleum	Potwin, Kans.	Crude Expan.	10,000 bbls.		Under Constr.	Jan 1, 1953		Sweco	Sweco
Vickers Petroleum	Potwin, Kans.	Thermofor Cat. Cracking			Under Constr.	Jan., 1953	So-Vac.	Sweco	Sweco
Warren Petroleum	Crossville, Ill.	Isopentane Fac.		$40,350	PAD Certified				

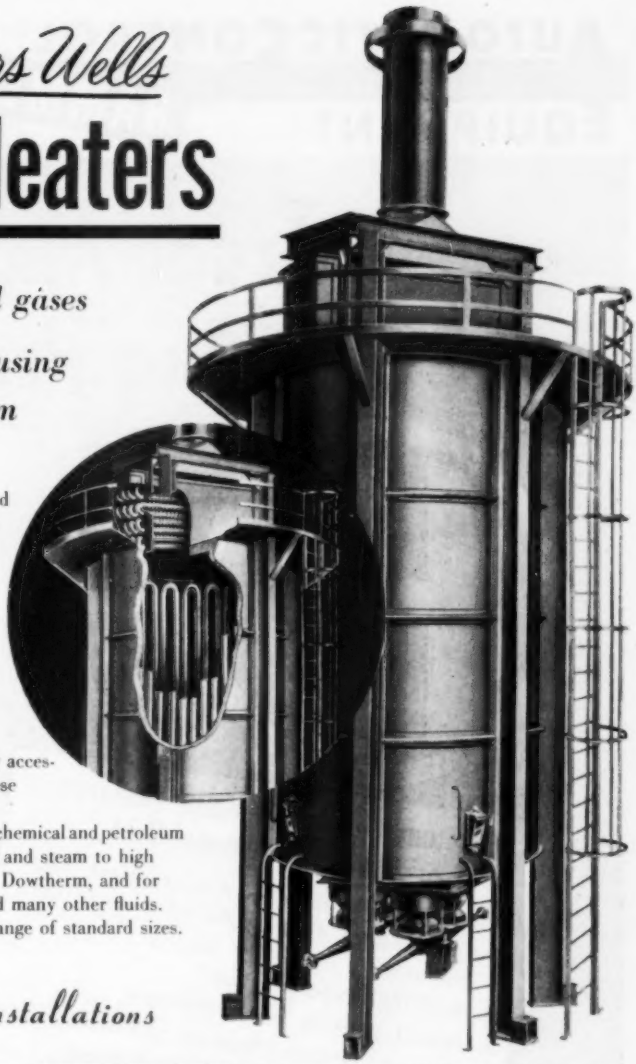
a Continued on page 87

Struthers Wells

Fired Heaters

For heating liquids and gases

For indirect heating using circulating medium



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Moderate rates of heat input, symmetrical arrangement of tubes, and the liberal heat absorption surface provided, eliminate overheating of the equipment or the heated fluid.

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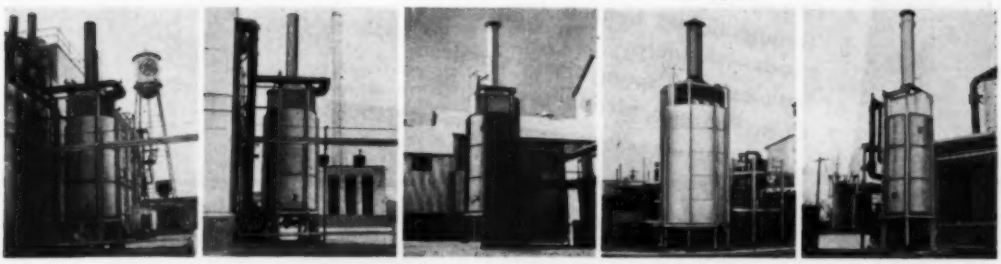

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REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

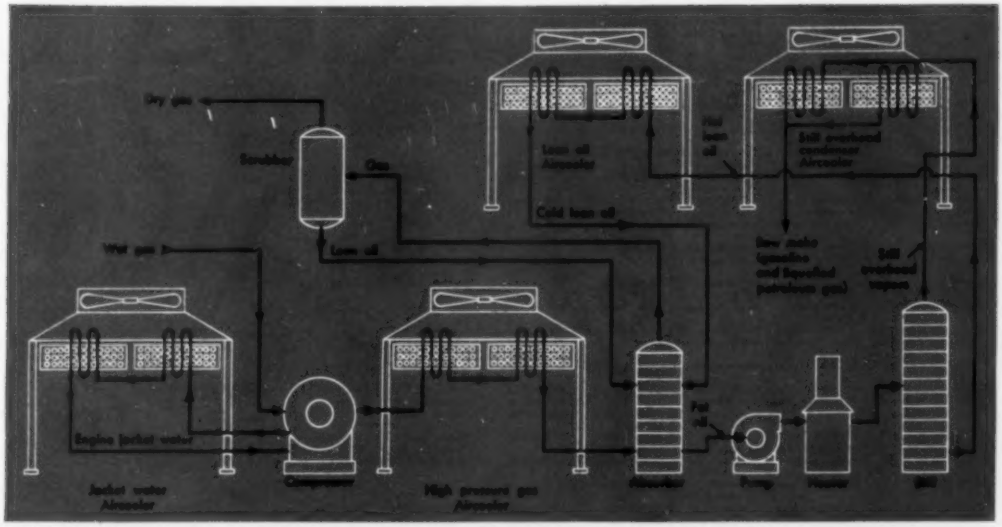
COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Warren Petroleum	Tulsa, Okla.	Propane & Butane		$566,320	Certified DPA				
White Eagle Petroleum	Augusta, Kans.	Therm. Cat. Reform.			Projected				
Wilcox Oil	Bristow, Okla.	Cat. Reformer	1,500 bbl.	$1 million	Under Constr.	Aug., 1953	U.O.P.	Procon	Procon
Williston Refining	N. Dakota	Complete Refg.	10,000 bbls.	$5 million	Announced		U.O.P.		
Wood River Oil Refining	Calumet, Ill.	Crude Topping, Crak.; Poly.	15,000 bbl. 6,800/600 bbl.	$1 million	Design				
SOUTHWEST									
Acadia Corp.	Shreveport, La.	Motor gas unit		$2.9 million	Design				
Allied Chemical & Dye (Solvay)	Orange, Texas	Petrochemicals Unit		$5 million	Projected	2 years			
American Petro-Chemical Corp.	Lake Charles, La.	Chem. Plt.	$15-20 million		Planned				
Aqua Dulce	Banquette, Tex.	Cycling Plt. Expansion		$750,000	Under Constr.	March 1, 1952		Fish Eng.	Fish Eng.
Aromatics Refining	Baton Rouge, La.	Aromatics Fac.		$11.6 million	Design				
Atlantic Refining Co.	Port Arthur, Texas	Detergent Mfg. Facilities		$1.5 million	Under Constr.	Early Fall, 1952		Atlantic	Badger Div.
Barnsdall Oil Co., Op.	Scurry Co., Tex.	Natl. Gaso. Plt.	50,000 mcf gas	$6.5 million	Considering				
Cabot Carbon Co.	Bayou Sale, St. Mary Parish, La.	Thermal Black Plt.	136,986 lbs.	$4 million	Designing	1952			
Cabot Carbon Co.	Bayou Sale, St. Mary Parish, La.	Oil Furn. Carbon Blk. Plt.	82,192 lbs.		Complete	1952		Staff	Staff
Carbide & Carbon Chemicals	Texas City, Tex	Acetylene Plt.			Under Constr.	Early 1953			
Carbide & Carbon Corporation	Texas City, Tex.	Polyethylene Resins Mfg.	140,000 lbs.		Under Constr.	Early 1953			
Carbide & Carbon Corporation	Seadrift, Texas	Polyethylene & Ethylene Glycol Mfg.	140,000 lbs.	$43 million	Under Constr.	Early 1953			
Celanese Corp.	Pampa, Tex.	Chem. Plt.		$3.5 million	Under Constr.	Oct., 1952		Brown & Root	Brown & Root
Cities Service	Lake Charles, La.	Fluid Hydroformer	10,000 bbls.		Engineering			Kellogg	Kellogg
Cities Service Oil	Pampa, Texas	Gasoline Expan.		$222,139	Certified DPA				Parsons
*Col-Tex Refining Co.	Colorado City, Texas	Platforming Unit			Planned				
Consolidated Chem. Ind.	Baton Rouge, La.	Sulfur	30 Long Tons	$350,000	Completed				
Consolidated Chemical, Ind.	Baton Rouge, La.	Sulfuric Acid	400 tons	$3.5 million	Under Constr.	Nov., 1952		Chemico	Chemico
Continental Oil	Lake Charles, La.	Refinery Expan.	40,000 bbl.	$24 million	Under Constr.	Jan., 1953	U.O.P.	Badger Div., Conoco	Badger Div., Procon
Cosden Petroleum Corp.	Big Spring, Texas	Reforming, Aromatics Units	4,000 bbls.	$3 million	Under Constr.	Summer 1952	U.O.P.-Dow	U.O.P.-Dow	Procon
Crown Central Petroleum	Houston, Texas	Crude Topping	2,350 bbl.	$265,000	Design				
Crown Central	Houston	Cat. Cracker	2,400 bbl.						
Davison Chemical	Lake Charles, La.	Catalyst Plt.		$7 million	Under Constr.	Early 1953		D & Z	Cond. Eng.
Del Ray Petroleum Co.	Chesterville, Texas	Pressure Absorption Plt.	25,000 mcf		Under Constr.			O. L. Olson	O. L. Olson
Del Ray Petroleum	Eagle Lake, Tex.	Nat. Gasoline		$4,000	Certified DPA				
Del Ray Petroleum	Eagle Lake, Tex.	Butane & Propane			Certified DPA				
Diamond Alkali	Houston, Texas	Petrochemicals Unit		$2 million	Contracted				Brown & Root
*Dow Chemical	Texas City, Tex.	Research Fac.		$2.6 Million	Under Constr.	1953			Southwestern
Dow Chemical	Freeport, Texas	Styrene Plastics		$1.6 million	Under Constr.			Braun	Braun
Dow Chemical	Freeport	Ethylene-Dibromide Unit		$8 million	Under Constr.			Braun	Braun
Dow Chemical	Freeport	Perchloraethylene Chloride		$3 million	Under Constr.			Braun	Braun
Dow Chemical	Freeport, Texas	Benzene Addi.		$1.2 million	Certified DPA				
Du Pont	Beaumont, Tex.	Petrochemicals Unit			Begin 1953				
E. I. Du Pont de Nemours & Co.,Inc	Orange, Texas	Expand Polythene Manuf. Facilities	60 mmcf		Under Constr.	Late 1952			
Eastern States Pet.	Houston Texas	Ethylene Mfg.		$4 million	Projected			U.O.P.	
Eastern States Pet.	Houston Texas	Rehab. Closed Plt.			Army Contract				
Esso Standard	Baton Rouge, La.	Aromatics Fac.			Under Constr.				Staff
Esso Standard	Baton Rouge, La.	Crude Distill.	300,000 bbls.	$51 million	Under Constr.	Early 1953		S.O.D.	Kellogg
Esso Standard	Baton Rouge, La.	Cat Cracker	31,000 bbls.		Under Constr.	Early 1953		S.O.D.	Kellogg
Esso Standard	Baton Rouge, La.	Crude Pipe Still	60,000 bbls.		Under Constr.	1954		Kellogg	Kellogg
Esso Standard	Baton Rouge,La.	Iso-octyle & Trideoyl Mfg. (alcohol)		$326,000	Announced				
Ethyl Corp.	Houston, Texas	Chemicals Mfg. Plt.	100 mln. lbs./yr.		Under Constr.	July, 1952		Braun-Badger Div.	Braun-Badger Div.
Ethyl-Dow	Freeport, Texas	Ethylene Dibromide	60,000 lbs.	$8.2 million					
Freeport Sulphur	Garden Is. Bay, La.	Sulfur Mining	1,400 tons	$10-15 million	Engineering	1953			
Gilmore Refineries	Odessa, Texas	New Refinery	50,000 bbls.	$40 million	Design				Ford-Bacon-Davis
Great Southern Chem.	Corpus Christi, Texas	Petro Chemicals		$5 million	Announced				
Gulf Oil	Crane Co., Tex.	Sulfur Unit		$200,000	Certified DPA				
Gulf Oil	Pt. Arthur, Tex.	Ethylene Plt.	45,000 lbs.	$15.4 million	Under Constr.	Summer, 1952		Lummus	Lummus
Gulf Oil Corp.	Pt. Arthur, Tex.	Iso-Octyl Alcohol Fac.	24,657 lbs.			Complete		Gulf	
Gulf Oil	Port Arthur, Texas	Sulfuric Acid Plt.	300 tons	$2,318,855	Under Constr.	Late, 1953		Leonard Constr.	Leonard Constr.
Gulf Oil	Port Arthur, Texas	Polymerization Plt.			Under Constr.	Late, 1952		Parsons	Parsons
Gulf Oil	Waddell, Texas	Sulfur Extrac.	20 tons		Under Constr.	February, 1952		Graff	Graff
Gulf Oil	Port Arthur, Texas	Sulfur Recovery Unit	60 tons	$586,390	Designing	Fall 1952		Parsons	Parsons
Heyden Chemical	Houston, Texas	Methanol fr Natural Gas		$12 million	Announced				
Humble Oil	Baytown, Texas	Sulfuric Acid Fac.		$808,000	Announced				

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
*Humble O&R	Pickton Field, Texas	Gas Comp. Plt.	†30.6 mmcf		Under Constr.	End, 1952			Stearns-Roger •
*Humble O&R Co.	Baytown, Texas	Paraxylene Plt.	66,000 lbs.		Planned	May, 1953			C. F. Braun
*Jefferson Chemical	Port Neches, Texas	Ethylene Oxide Ethylene Glycol			DPA Certified				
*Jefferson Chemical	Port Neches, Texas	Phenol Mfg. Facilities			Under Constr.	July, 1953			
Koppers Co., Inc.	Pt. Arthur, Tex	Chem. Plt.		$6 million	Under Constr.	Oct., 1952		Koppers	Koppers •
Levelland Refining	Amarillo, Texas	Cat. Crk. Poly.	3000/150 bbls.	$2.4 million	Design				
*Lion Oil Co.	Luling, La.	Chemical Plt.	300 tons	$31 Million	DPA Certified				
Lone Star Producing Company	Ft. Chadbourne, Texas	Gasoline Plt.	30 mmcf	$3 million	Under Constr.				
Magnolia	Hurricane Creek Field, Beauregard Parish, La.	Casinghead Gasoline Plt.			Designed				
Magnolia Petroleum	Beaumont, Tex.	Therm. Cat. Reforming	17,000 bbls.	$10 Million	Projected		So-Vac.		
Magnolia Petroleum	Midland Co., Texas	Nat. Gas & Butane		$8.3 million	Certified DPA				
Mayfair Minerals	McAllen, Texas	Natural Gas Plt.			Announced				
McBride Refining	Edinburg, Tex.	Modernization	3,500 bbls.		Under Constr.				
McBride Refining	Edinburg, Tex.	Catalytic Reform. Unit	800 bbls.		Under Constr.	July 1, 1952			
Monarch Refining	San Antonio, Texas	Fluid Cat. Crk.	4,000 bbl.					U.O.P.	Koch
Monarch	San Antonio	Poly. Unit	2,500 bbl.	$12.5 million	Design	Mid 1953			
Monarch	San Antonio	Alky. Unit	2,500 bbl.						
Monsanto	Texas City	Styrene Plastics		$26 million	Under Constr.	April, 1952			
Monsanto	Texas City, Tex.	Vinyl Chloride		$7.3 million	Announced			Braun	
Monsanto Chemical Co.	Texas City, Tex.	Acrylonitrile Mfg. Facil.; Plt. Expansion		$30 million	Engineering	1952		Hudson	Hudson
Ohio Oil	Matagorda, Tex	Gas Processing Plt.	91 million cu. ft.	$4.1 million	Complete				
*Onyx Refining Co.	Abilene, Texas	Platformer	650 bbls.		Design	1st Qtr., 1953	UOP	Procon	Procon
		Expansion	†500 bbls.		Planned				
Pan Am Petroleum & Trans.	Texas City, Tex	Av-Gas Expan.	†1,150 bbls.		Plan	End 1952			
Pan Am Southern Corp.	Destrehan, La.	Cat. Crk. Unit Gas Plt., Alkylation	15,000 bbls.	$6.5 million	Under Constr.	Sept., 1952		Lummus	Lummus
Pan-Am Southern	Destrehan, La.	Refinery Expan.		$5.5 million	Under Constr.	Sept., 1952			
Pan-Am Southern	Destrehan, La.	Fluid Hydro-former	2,000 bbl.		Under Constr.			Kellogg	Kellogg
Pan-Am Southern	Destrehan, La.	Coker	9,000 bbls.		Begin 1952	Nov., 1952		Lummus	Lummus
Pan American Refining	Texas City, Texas	Refinery Expan.	†12,000 bbls. Crude	$1.8 million					Lummus[1] •
Pan American Refining	Texas City, Texas	Fluid Cat[1]	†30,000 bbls.[1] Cracking						Texas-Gulf
Pan American Refining	Texas City, Texas	Poly Unit	†2,400 bbls. Avgas						
Panhandle Prod. & Ref.	Wichita Falls, Texas	Topping Unit	8,000 bbl.		Design			Ref. Eng.	
Panoma Corp.	Carson City, Tex.	Avgas	14,611 bbls.	$1 million	Under Constr.	Sept., 1952		Gas Plt. Constr.	Gas Plt. Constr. •
Pecos Petroleum	Pecos, Texas	Aromatics Expansion	240/260 bbls.		Planned				
Phillips Chemical	Houston, Texas	Chem. Plt.		$2.5 million	Under Constr.	1953			
Phillips Oil	Borger, Texas	Alky. Expan.		$15.5 million	Announced				
Phillips Pet.	Chocolate Bayou, Texas	Nat. Gas Plt.	3,570 bbl.		Announced				
*Phillips Pet. Co.	Brazoria Co., Texas	Natural Gaso.	†100,000 cu. ft.		Under Constr.	Nov., 1952		Phillips	Phillips
Phillips Pet.	Midland, Texas	Nat. Gas Plt.	100 mcf		Under Constr.				
Phillips Petroleum	Sherman County, Texas	Natural Gas Plt		$212,090	Under Constr.				
Phillips Petroleum	Houston, Texas	Petrochemicals	400 tons	$38 million	Under Constr.	2nd Qtr., 1953		Phillips	Fish
Phillips Petroleum	Ector City., Tex	Natural Gasoline	75,000 cu. ft.	$900,000	Complete				
Phillips Petroleum	Gray Cty., Tex.	Natural Gasoline		$409,612	PAD Certified				
Phillips Petroleum	Hutchinson City, Texas	Natural Gasoline Equip.		$169,165	PAD Certified				
Phillips Petroleum	Moore Cty., Tex	Natural Gasoline		$1 million	PAD Certified			Staff	Staff
Phillips Petroleum	Midland, Texas	Expanded Gasoline Mfg.	†60,000 cu. ft.	$9.6 million	Under Constr.	Oct., 1952			
Phillips Petroleum	Ector Co., Tex.	Butanes-Pentanes Mfg.		$5.4 million	Certified DPA				
Phillips Petroleum	Borger, Texas	Cyclohexane Mfg.		$1.5 million	Certified DPA				
Phillips Petroleum	Borger, Texas	Propane & Isobutane		$2 million	Certified DPA				
*Phillips Pet. Co.	Upton Co., Tex.	Natural Gaso.	†30,000 cu. ft.	$2 million	Under Constr.	May, 1953		Phillips	Phillips
Pontiac Refining	Corpus Christi, Texas	Avgas Expan.		$3.6 million	PAD Certified				
Premier Pet.	Ft. Worth	Jet Fuel Butane, etc			Design				
Premier Petroleum	Ft. Worth, Tex.	Refinery Expan.	6,000 bbls.	$10.8 million	Planned				
Pure Oil	Smiths Bluff, Texas	Basic Refining		$390,000	Announced				
Pure Oil	Smiths Bluff, Tex.	Alkylate Unit	1,901 bbl.		Start 1952			Kellogg	Kellogg
Pure Oil	Smiths Bluff, Tex.	Cat. Poly	135		Start 1952			Kellogg	Kellogg
Pure Oil	Smiths Bluff, Texas	Expanded Alkylation	1,900 bbls.	$390,000					
Pure Oil	Smiths Bluff, Texas	Modernization		$11 million	Under Constr.	Spring, 1953		Kellogg	Kellogg
Pure Oil	Smiths Bluff, Texas	Orthoflow Crk.	15,000 bbls.		Start 1952			Kellogg	Kellogg
Pure Oil	Smiths Bluff, Tex.	Feed Prep-Vac Flash	20,000 bbls.					Procon	Procon
Republic Oil Ref.	Texas City, Tex.	Platforming Unit	6,500	$7 million	Under Constr.	Spring, 1953	U.O.P.		
Republic Oil Ref.	Texas City, Tex.	Crude Dist.	†30,000	$6.6 million	Announced				
Republic Oil Refining	Texas City, Tex.	Gasoline Mfg.		$80,000	Planning				
Shamrock Oil & Gas Corp.	McKee, Texas	Reconstruct Gaso. Ref. Treater						Lummus	Lummus •
Shamrock Oil & Gas	Sunray, Texas	Coking Unit	1,000 bbls.	$500,000	Under Constr.	Mid 1952			
Shamrock O&G	Sunray, Texas	Avgation Alkylate	10,000 bbls.	$2 million	Announced	March, 1953			
Shamrock O&G	Sunray, Texas	Sulfur Extrac.		$195,500	Announced			Pioneer	Pioneer
*Shell Chemical	Houston, Texas	SBA-MEK Expansion			Under Constr.	Dec., 1952		Parsons	Parsons
Shell Chemical	Houston, Texas	Sulfur Recovery Unit	55 tons	$500,000	Under Constr.	Oct., 1952			

• Continued on page 90

- ☛ cooling engine jacket water
- ☛ cooling high pressure gas
- ☛ condensing overhead vapors
- ☛ cooling lean oil



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ALCO Aircoolers demonstrate their versatility in natural gasoline plants. The simplified flow diagram above shows how Aircoolers are used to cool jacket water, cool high pressure gas, condense overhead vapors and cool lean oil.

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REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Shell Chemical	Houston, Texas	Epon Resins		$1.5 million	Engineering	Sept., 1953		Badger, Fluor	Badger, Fluor
Shell Oil	Houston, Texas	Benzene-Toluene	1,250/2,500 bbl.	$4.6 million	Under Constr.	Late 1952		Foster Wheeler and Fluor	Foster Wheeler and Fluor
Shell Oil Co.	Houston, Texas	Platforming Unit	15,000 bbl.	$12 million	Under Constr.			U.O.P.	Procon
Shell Oil	Norco, La.	Expansion	†25,000 bpd	$30 million	Design				
Shell Oil	Houston, Texas	Avgas Components		$1 million	Certified DPA				
*Shell Oil Co.	DeWitt & Victoria Cos., Tex.	Gas Comp. Plt.	12 mmcf		Under Constr.	Nov., 1952			Olsen
Sid N. Richardson	Odessa, Texas	Sulfur Recovery	20 tons	$130,830	Under Constr.	1952		Graff	Graff
Sid Richardson Refining Co.	Texas City, Tex.	Refinery Alterations	30,000 bbls.		Under Constr.			Staff	Staff
Sinclair Refining	Houston, Texas	Crude Topping	25,000 bbl.	$33.6 Million	Under Constr.	Fall 1953		Staff-Fluor	J. G. White
Sinclair	Houston	Cat. Cracker	40,000 bbl.						
Sinclair Refining	Houston Texas	Barium Sulfonate		$145,700	Certified DPA				
South Texas Corp.	Neuces Co., Tex.	Expanded Products Mfg.			Announced				
Southwestern Oil & Refining	Corpus Christi, Texas	Crude Topping	15,300 bbl.	$5.5 million	Design		U.O.P.	Ref. Eng.	Ref. Eng.
Southwestern	Corpus Christi	Cat. Crk.-Poly.	5,000/200 bbl.						
Standard (Texas)	El Paso, Texas	Alkylation Unit	1,400 bbl.	$2.7 million	Under Constr.			Kellogg	Cat. Constr.
Standard (Texas)	El Paso	Expansion & Modern Crk.	11,000 bbl.	$10.2 million	Under Constr.	July, 1952	Houdry	Cat. Constr.	Cat. Constr.
Standard (Texas)	Houston, Texas	Natural Gasol		$1.2 million	Announced				
Stanolind Oil	Shreveport, La.	Gas Stripping	1.5 million cu. ft.		Under Constr.			Blaw-Knox	Blaw-Knox
Stanolind O&G	Sundown, Texas	Sulfur Recovery Unit	49 long tons		Under Constr.	Sept., 1952		Fluor	Fluor
Stanolind O&G	Odessa, Texas	Sulfur Rec. Plt.	17.7 long tons		Under Constr.	Early 1953		Girdler Corp.	Girdler Corp.
Stanolind O&R	Andrews Co., Texas	Nat. Gasoline		$2.7 million	Certified DPA				
Sunray	Corpus Christi, Texas	Cat. Cracking Refinery	28,000 bbls.	$16 million	Under Constr.	Summer 1953	U.O.P.	Lummus	Lummus
Taylor Refining	Corpus Christi, Texas	Aromatics Fac.	3,750 bbls.	$3.7 million	Engineering	June, 1953	UOP	UOP	Staff
Taylor Refining	McAllen, Texas	Natural Gas Plt.			Complete				
Texas City Refining	Texas City, Tex.	Modernization		$3 million	Engineering	1953		Henry Kaiser Engineers	Henry Kaiser Engineers
Texas City Refining	Texas City, Tex.	Modernization		$3 million	Eng. Studies	1953		Henry Kaiser Engineers	
*Texas City Refining	Texas City, Tex.	Cat. Cracker	19,000 bbls.	$2.4 Million	Under Constr.	End, 1952	Houdry	Houdry	Kaiser
Texas City Refining	Texas City, Tex.	Avia-Alkylate		$2.5 million	Certified DPA				
Texas Eastman	Longview, Tex.	Petrochemicals	20,000 bbls. Propane	$5.7 million	Partial Oper.				
Tex.-Harvey Gas	Midland, Texas	Gas Plt.; Refrig.	35 mcf wet	$5.5 million	Initial Oper.	July, 1952			
The Texas Co.	Pt. Arthur, Tex.	Expansion	20,000 bbls.		Under Constr.	1953		Texas Co.	
The Texas Company	Port Arthur, Texas	Gasoline Plt.	18,500 bbls.	$1,286,000	Approved DPA	1953			
*Texas Co.	El Paso, Texas	Expansion, Modernization	†5,000 bbls.		Planned	Late, 1954			
The Texas Company	Amarillo, Texas	Av-Gasol Fac.	47,000 bbls.	$20,750,000	Approved DPA	Late, 1954			
United Carbon Co.	Shamrock, Texas	Carbon Black Plt.	68,500 lbs.	$1.5 million	Under Constr.				
United Gas Pipe Line	Sterlington, La.	Dehydration	†25,000 mcf		Under Constr.				Staff
United States Rubber Co.	Baton Rouge, La.	Buna W Rubber Plt. Expan.	82,200 lbs.		Under Constr.	Early, 1952			
Universal Oil Products	Mooringsport, La.	Synthetic Cat. Mfg.			Announced				
Wickett Refining	Wickett, Texas	Thermal Crker	2,000 bbls.		Under Constr.				
Wilshire & Lone Star Gas	Upton Co., Tex.	Nat. Gaso. Plt.	50 mmcf	$2 million	Completed			Staff	
ROCKY MOUNTAIN									
Arizona Interests	Florence, Ariz.	Refinery	15,000 bbls.	$25 million	Planning	Jan., 1953		Fluoco	
Bay Petroleum	Denver, Colo.	Fluid Cat. Crk.	3,500 bbls.	$1.9 Million	Under Constr.	Jan., 1953	U.O.P.	Procon	Procon
Bay Petroleum	Denver, Colo.	Crude Expan.	6,000 bbls.		Under Constr.			Procon	Procon
Bureau of Mines	Rifle, Colo.	Demonst. Retort.	150-400 ton	$333,870	Under Constr.	June, 1952		Blaw-Knox	Staff
California Co.	Rangely, Colo.	Products Addi.		$700,000	Under Constr.	Oct., 1952		Delta	Delta
*Continental Oil Co.	Johnson Co., Wyoming	Gasoline Plt.			Announced				
Continental Sulphur & Phosphate Corp.	Thermopolis, Wyo.	Sulfur Extraction			Planning				Chemico
Farmers Union Central Exc.	Laurel, Mont.	Fluid Cat. Crker.	5,000 bbls.	$3.5 million	Under Constr.	Nov., 1952	U.O.P.	Ref. Eng.	Ref. Eng.
Garfield Chemical & Mfg. Corp.	Salt Lake City	Sulfuric Acid		$2.5 million	Plan				
Gen'l. Pet. Corp.	Worland, Wyo.	Gasoline Ext. Plt.	8 mmcf	$4 million	Certified DPA				
*Malco Refineries	Prewitt, N.M.	Expansion	†1,500 bbls.	$500,000	Under Constr.	Sept., 1952	Atlantic, UOP	Grebe & Doremus	Grebe & Doremus
Oriental Refining Co.	Denver, Colo.	Perco Cyclovertion Unit	1,500 bbls.		Under Constr.				
Phillips Chem.	Eunice, N. M.	Sulfur Extrac.	100 tons	$1.5 million	Contracted				
Phillips Petroleum	Lea Cty., N. M.	Natural Gasoline		$27,150	PAD Certified				
Phillips Petroleum Co.	Woods Cross near Salt Lake City, Utah	Vac. Plt., Gas Plt.; Storage, Cat. Crk.	8,000 bbls.	$10 million	Under Constr.	July, 1952		Fluor	Fluor
Phillips Petroleum	Woods Cross, Utah	Expanded Gasoline Fac.	8,000 bbls.	$5.7 million	Under Constr.	Sept., 1952			Fluor
Phillips Petroleum	Great Falls, Montana	Refining		$3 million	Certified DPA				
Pure Oil	Worland, Wyo.	Sulfur Recovery Plt., etc.	30 million cu. ft. gas		Engineering			Foster Wheeler	Tex. Gulf Sulphur
Utah Oil Ref.	Salt Lake City, Utah	Expansion: Treating, Storage		$1 million	Under Constr.	Sept., 1952		CB&I	CB&I and Sterne-Roger
Western States Refg.	Salt Lake City, Utah	Topping: Crker.	3,000/2,200 bbls.	$1.1 million					
WEST COAST									
Caminol Co.	Hanford, Calif.	Motor Gasoline & Distillate			Announced				
Dow Chemical	Pittsburgh, Cal.	Methylene Chloride		$670,000	Under Constr.	June, 1952			
Ethyl Corp.	Wilmington, Calif.	Gasoline Facilities		$184,125	PAD Certified				
Eureka Refining	Long Beach, Cal.	Cat. Crker.	6,000 bbls.	$2.2 million					
General Petroleum	Torrance, Calif.	De-isobutanizer Tower, Alkylation Re-Run		$575,000	Under Constr.	June, 1952		G. P. Staff	J. B. Gill

■ Continued on page 92

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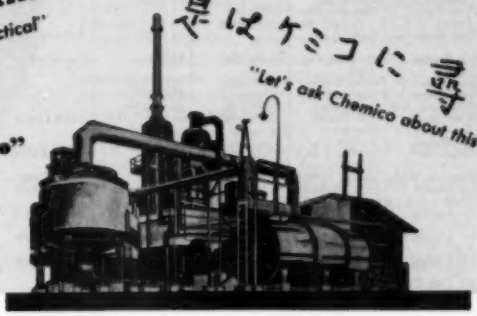

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REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
General Petroleum	Torrance, Calif.	Therm. Cat. Reform.	39 Million		Projected		So-Vac.		
Hancock Oil Co.	Long Beach, Cal.	Ethylene Glycol	20,000 bbls.		Under Constr.			Badger Div.	Badger Div.
Hancock—Calif.	Long Beach, Calif.	Aviation Gasoline		$3 million	PAD Certified				
Hancock Chem.	Long Beach, Calif.	Sulfur Extraction Exp.	50 tons	$250,000	Under Constr.	Feb., 1952		Parsons	Parsons
Mohawk Petroleum	Bakersfield, Calif.	Jet Fuel Prod.		$3 million	Announced				
Monsanto	Avon, Calif.	Sulfuric Acid Plt.	250 tons		Engineering	End 1953		Monsanto	Leonard Constr.
Navy	San Joaquin, Calif.	Natural Gas Plt.	50,000 mcf	$5 million	Under Constr.				Parsons-Macco
Richfield Oil	Watson, Calif.	Expansion; Cat Cracker; Aromatics	6,000 bbls.	$43 million	Under Constr.			Braun	Braun
*Richfield, Oil	Los Angeles, Calif.	Refinery Expan.	†20,000 bbls.	$4 Million					
Rothschild Oil	Santa Fe Springs, Cal.	Cat. Crker.	6,000 bbls.	$2 million					
Shell Chemical	Shell Point, Calif.	Synthetic Ammonia Plt.			Planning				
Shell Oil	Shell Point	Refinery	25,000-50,000 bbls.	$25 million	Planning				
Shell Chemical	Ventura, Calif.	Synthetic Ammonia Plt.			Under Constr.	July, 1953		Kellogg	Kellogg, Gibbs & Hill
Shell Oil	Martinez, Calif.	Sulfonates		$476,000	Certified DPA	Aug., 1952		Bechtel	Bechtel
Shell Oil Co.	Wilmington, Calif.	Distillation Tower	52,000 bbls.		Adv. Design	Early 1954			
Shell Oil Co.	Martinez, Calif.	Distilling Expan.	†5,000 bbls.		Under Constr.	Sept., 1952			
Signal Oil & Gas	Los Angeles, Cal.	Butanes-Isobutane		$500,000					
Standard (Calif.)	Richmond, Calif.	Lube Oils	4,500 bbls.	$1.5 million	Complete		Petreco	Staff	Bechtel
Standard (Cal.)	El Segundo	Feed Preparation	23,000 bbls.	$2.5 Million	Under Constr.	Aug., 1952		Fluor	Fluor
Standard (Cal.)	El Segundo	Platformer	10,000 bbls.	$3 Million	Under Constr.	Sept., 1952	U.O.P.	U.O.P.	Procon
Standard (Calif.)	Richmond, Calif.	Chem. Plt.	13 mln. lbs./yr.	$1.5 million	Engineering	Jan., 1953			
Standard—Calif.	Richmond, Calif.	Synthetic Phenol	35 mln. lbs./yr.	$4 million	Engineering	July, 1953			
Standard—Calif.	Richmond, Calif.	Benzene		$1,187,000	Complete				
Standard Oil-Calif.	Richmond, Calif.	Vacuum Flasher	55,000 bbl.		Under Constr.			Kellogg	Kellogg
Standard Oil-Calif.	Richmond, Calif.	Modernization			Under Constr.			Kellogg	Kellogg
Standard Oil of Calif.	Richmond, Calif.	TCC to Houdry	7,500 bbls.	$9 million	Under Constr.	Dec., 1951	Houdry	Houdry	Bechtel
Standard Oil of Calif.	El Segundo, Calif.	Benzene Plt.	850 bbls. Benzene, 3,200 bbls. Toluene	$10 million	Under Constr.	Mid 1952	U.O.P.	Fluor	Fluor
Stauffer Chemical	Compton, Calif.	Sulfuric Acid Fac.		$57,070	Engineering				
Stauffer Chemical	Richmond, Cal.	Sulfuric acid		$283,500					
Sunray Oil	Santa Maria, Cal.	Reconstruction	5,000 bbls.					Procon	Procon
Union Oil Co. of Cal.	Brea Olinda, Cal.	Research Plt.		$5 million	Projected			Austin, Field and Fry	Walker
Union Oil Co.	Los Angeles, Calif.	Fluid Cat. Crk. Unit	28,500 bbls.	$7 million	Completed	June, 1952	U.O.P.	McKee	McKee
Union Oil	Los Angeles, Cal.	Crude Topping	20,000 bbls.	$12 million					
Union Oil	Los Angeles	Alkylate Fac.	250 bbls.	$155,000					
Union Oil	Wilmington, Cal.	Cat. Cracker	28,500 bbls.	$4.5 million					
Union Oil	Wilmington, Calif.	Acid Treater Rerun	15,000 bbls.		Under Constr.			Union-Braun	Braun
Union Oil	Wilmington	Av. Gas		$135,000					
Union Oil	Oleum, Calif.	Gasoline & Fuel Expan.		$84,780	Certified DPA				
Union Oil Co.	Edmonds, Wash.	Asphalt Refinery	65,000 tons		Under Constr.				Bechtel
Union—Calif.	Los Angeles, Calif.	I.C.C. Revision		$2.6 million	Under Constr.	June, 1952	Houdry	McKee	McKee
Union—Calif.	Los Angeles, Calif.	Crude Dist;	40,000 bbls.	$7 million	Under Constr.	Nov., 1952		Fluor	Fluor
Union—Calif.	Los Angeles, Calif.	Acid Treat. & Rerun;	15,000 bbls.	$1.7 million	Under Constr.	Aug., 1952		Braun	Braun
Union—Calif.	Los Angeles, Calif.	H2S Recovery System		$540,000	Under Constr.	June, 1952		Girdler Corp.	
U. S. Navy and Standard Oil of Calif.	Elk Hills, Calif.	Nat. Gas Plt.	50 mmcf	$45 million	Planned	April, 1952			
FOREIGN									
Canada									
British-American	Moose Jaw, Sask.	Crude	15,000 bbls.						
British-American	Moose Jaw, Sask.	Thermal Crk.	1,500 bbls.	$8 million	Under Constr.	July, 1952	U.O.P.	Texas	Can. Kellogg
British-American	Moose Jaw, Sask.	Cat. Cracking	4,500 bbls.						
British-American Oil	Clarkson, Ont.	Grease plt.	42,000 lbs.	$1.5 million	Engineering	Late 1952		C. W. Nofsinger	
British American Oil and Shawinigan Chemicals	Montreal, East	Petro Chemical Plt.—Phenol	36,000 lbs.	$3 million	Under Constr.	Oct., 1952	Hercules	Can. Kellogg.	Can. Kellogg
Cabot Carbon of Canada	Sarnia, Ont.	Carbon Black Plt.	54,000 lbs.	$1 million	Under Constr.	Jan., 1953		Staff	Stone & Webster
Canadian Chemical Co.	Edmonton Area, Alberta	Petro Chemical Plt.		$50 million	Under Constr.	Sept., 1952		Celanese-Brown Root	Brown Root
Canadian Oil Refineries	Froomfokl, Ont	Refinery Plat. Unit	20,000 bbls. 3800 bbls.	$18 million	Under Constr Completed	April, 1952 1952	U.O.P	Can. Kellogg U.O.P.	Can. Kellogg. Procon
Canadian Industries	Montreal, Quebec	Polyethylene Mfg.		$13 million	Start Spring	Late 1953			
*Canadian Industries, Ltd.	Edmonton, Alta.	Polythene Plt.	16.6 tons		Announced	Late, 1953			
Celanese Corp.	Edmonton, Alta.	Chemical Plt.		$40 million	Announced				
Dominion Tar & Chemical Co., Ltd	Montreal East	Petro Chemical Plt		$50 million	Design	End 1952		Badger	Badger
Imperial Oil	Edmonton, Alberta	Fluid Cat. Crk., Gas Recov. Plt Vac. Dist. Unit	22,000 bbls.	$5.5 million	Under Constr.	Summer 1952		Staff	Foster Wheeler
Imperial Oil	Sarnia	Fluid Cat. Crk., Dist., Light Ends Recov	71,000 bbls.	$14.6 million	Under Constr.	Summer 1953		Staff	Can. Kellogg
Imperial Oil	Sarnia	50 Storage Tanks	3 million bbls.		Under Constr.	Summer 1952		Toronto Iron Works	Horton Steel
Imperial Oil	Ioco, B. C.	Cat Cracker	†10,500 bbls.	$13.5 million	Field Constr.	Fall 1953		Staff	Tenders out
Imperial Oil	Regina, Sask.	Modernization & Expan.	†2,500 bbls.	$7 million	Plan	Early 1954		Staff	Tenders
Midland Pet. & Pacific Pet.	Stettler, Alta.	Crude Refinery	4,000 bbls.	$2 million	Under Constr.			Procon	Procon

• Continued on page 95

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we know how to custom fabricate equipment that will

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Usually standard equipment, or its modification, will get the job done; sometimes it won't. BS&B has successfully served the petroleum industry for 60 years. That's why we're constantly being called in to design and fabricate equipment to the exact specifications of customers with problems peculiar to their particular operation. Through these 60 years BS&B has remained alert to the rapidly changing oil and gas and refining industry business that you may always have the latest — the best equipment. By now you know that behind our designing, engineering and fabricating service is EFFICIENCY and RELIABILITY. To further serve you BS&B has added a total of 135,000 sq. ft. of manufacturing area to its Oklahoma City and Kansas City plants.

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4. Maybe your job weighs 150 tons... we can handle. Our new 2000° F. stress relieving furnace measures 15'-8" wide, 80' long and 15'-8" high above car.
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REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Panther Oil and Grease Co.	Leaside, Toronto, Ontario	Grease and Compounding	.....	.....	Projected	.....	.....	.....	.....
Royalite Oil	Turner Valley, Calgary	Sulfur Recovery	30 Long tons	$350,000	Complete	.....	.....	Foster Wheeler	Foster Wheeler
Shell (Canada)	Montreal, East	Petro Chem Plt	50,000 lbs.	$3 million	Under Constr.	Late 1952	.....	.....	.....
Shell Oil	Shellburn, Ver.	Refinery Warehouse	.....	$300,000	.....	.....	.....	.....	.....
Sun Oil	Sarnia, Ont.	Refinery	10 ,000 bbls.	$10 million	Spring, 1952	March, 1953	Houdry-Sun	Cat. Const.-Sun	Cat. Constr.
Supreme Refineries	Ondet, Alta.	Asphalt Plt.	.....	.....	Planning	.....	.....	.....	.....
*Tor American Oils Ltd., & Tritor Oils, Ltd.	Alberta, Canada	Refinery	.....	.....	Planned	.....	.....	.....	.....
Latin America									
Brazilian Govt.	Sao Mateus (Santo) Brazil	Shale Oil Pilot Plt.	100 bpd	$500,000	.....	.....	.....	.....	.....
Brazilian Investments	Niterey, Rde J. Brazil	Refinery	20,000 bbls.	.....	Petitioned	.....	.....	.....	Kellogg
Cia Industrial de Rochas Betuminosas	Between Rio-Sao Paulo, Brazil	Shale oil pilot Plt.	20 bpd	.....	Nearing Completion	.....	.....	.....	.....
*Compania Espanola de Petroleos, S.A.	Santa Cruz, Tenerife	Platforming Unit	5,000 bbls.	.....	Under Constr.	Late, 1953	UOP	.....	Procon
Conselho Nacional do Petroleo	Bahia, Brazil	Expansion	5,000 bbls.	.....	Under Constr.	.....	.....	Kellogg	Kellogg
Conselho Nacional do Petroleo	Cubatao, Sao Paulo, Brazil	Therm. Crk. Ref Reforming, Vis Breaking Cat. Poly	45,000 bbls.	.....	Under Constr.	Mid, 1953	.....	PA Hydro Ren.	PA Hydro Ren. and McKee
Conselho Nacional do Petroleo	Matarire, Bahia, Brazil	Ref Expn. Cat. Poly L.P.G., Plt.	2,500 bbls.	$3.5 million	Under Constr.	Sept., 1952	.....	Kellogg	Kellogg
Concelho Nacional	Salvador, Brazil	Cat. Poly. LPG	5,000 bbls.	.....	Under Constr.	.....	.....	Kellogg-P.A., Hydro. Ren.	Staff
The Corporacion de Fomento de la Produccion	Concon, Valparaiso, Chile	Refinery	14,000 bbls.	$9 million	Planning	1953	.....	.....	.....
Creole Pet. Corp	El Roble Field, Venezuela	Repressuring	.....	.....	Planning	.....	.....	.....	.....
Creole Petroleum	Jusepin, Venezuela	Revamp Ref.	15 mmcf 450 bbls.	.....	Under Constr.	Nov., 1952	.....	.....	Braun
Diadema, Argentina	Buenos Aires, Arg.	Luboil Refining	600 bbls.	.....	Projected	.....	.....	.....	.....
Empresa Nacional de Petroleo	Concon, Chile	Refinery	20,000 bbls.	$10 million	Begin 9-52	.....	.....	P.A., Kellogg	P.A., Kellogg
International Petroleum (Colombia)	Barrancabermeja, Colombia	Refinery Modernization	35,000 bbls.	$20-25 million	Under Constr.	Late 1954	.....	Foster Wheeler	Foster Wheeler
Iparanga S.A. Cia Brasilira de Petroleos	Rio Grande, Brazil	Therm. Crk. Ref.	2,000 bbls.	.....	Authorized	1953	Foster Wheeler	.....	.....
Monsanto S.A.	Sao Paulo, Brazil	Plastics Plt.	.....	.....	Under Constr.	Late 1952	.....	.....	.....
Petroleos Mexicanos	Mazatlan	Refinery	15,000 bbls.	$1.7 million	Projected	.....	.....	.....	.....
Petroleos Mexicanos	Ciudad Madero, Mexico	Desulfurization Units	12,000 bbls.	$1.5 million	Under Constr.	Dec., 1952	Pereo	McKee-Phillips	McKee
Petroleos Mexicanos	Tamaulipas, Ciudad Madero Mex.	Enlarge Refinery Capacity	47,250 bbls.	.....	Planning	.....	.....	.....	.....
*PEMEX	Guaymas, Mex.	New Refinery	10,000 bbls.	$1.3 Million	Projected	.....	.....	.....	.....
Petroleos Mexicanos	Tamaulipas, Arbol Grande Pet., Mex.	Enlarge Refinery	16,600 bbls.	.....	Planning	.....	.....	.....	.....
Petroleos Mexicanos	Mata Redonda, Vera Cruz, Mex.	Improvements	9,000 bbls.	.....	Planning	.....	.....	.....	.....
*PEMEX	Poza Rica, Mex.	Expansion	†100 mmcf	$3.6 Million	Under Constr.	1954	.....	McKee	McKee
Petroleos Mexicanos	Poza Rica, Mex.	Improvements to Skimming Plant	3,100 bbls.	.....	Planning	.....	.....	.....	.....
Petroleos Mexicanos	Reynosa, Mex.	Expansion	.....	.....	Planning	.....	.....	.....	.....
Petroleos Mexicanos	Salina Cruz, Mexico	Refinery	10,000 bbls.	$752,000	Planning	.....	.....	.....	.....
Petroleos Mexicanos	Salamanca, Mex.	Lube Oil and Paraffin Plt.	2,200 bbls. Lube 143,000 lbs. Wax	$30 million	Under Constr.	1954	Texaco	McKee	McKee
Petroleos Mexicanos	Tampico, Mex.	Modern., Sulfur Ext.	.....	$1.5 million	.....	1952	.....	.....	.....
Petroleos Mexicanos	Minatitlan, Mexico	Modern., Sulfur Ext.	.....	$1.5 million	.....	1952	.....	.....	.....
Phillips Oil Co	San Rogue Fld., Anzoategui, Venezuela	Refinery, Wax Plt.	2 mln. lbs. wax/ year	.....	Under Constr.	April, 1952	.....	Pritchard	C. B. & I.
Phillips	San Rogue Fld., Anzoategui, Venezuela	Crude Stab. and Pressure Maint. Plt.	10,000 bbls. and 38 mmcf	.....	Planning	.....	.....	.....	.....
Phillips	San Rogue	Crude Distill.	2,000 bbls.						
Private Group	Rio de Janeiro, Brazil	Refinery	20,000 bbls.	.....	.....	.....	.....	.....	Kellogg
Puerto Rican Oil Refining Co.	Near Ponce, Puerto Rico	Refinery	25,000 bbls.	$30 million	Projected	.....	Undetermined	Parsons, Brinckerhoff, Hall and Macdonald	.....
Refinaria de Petroleo do Distrieto Federal S.A.	Manguinhos, Brazil	Refinery	10,000 bbls.	$10 million	Contracted	Aug., 1952	.....	.....	.....
Refinaria de Petroleos do Distrito Federal S.A.	Rio de Janeiro, D. F. Brazil	Therm. Crk.	10,000 bbls.	.....	Authorized	.....	.....	Foster Wheeler	Foster Wheeler
Refinaria e Exploracao de Petroleo Uniao S.A.	Capuava, Sao Paulo, Brazil	Therm. Crk. Ref.	25,000 bbls.	$16.5 million	Under Constr.	End 1952	So-Vac.	P.A. Hydro. Ren.	P. A. Hydro. Ren.
Reunidas F Materazzo	Sao Paulo, Brazil	Contact Sulfur Acid Plt.	60 tons	.....	Ordered	.....	.....	.....	Chemico
Richmond Exploration Co.	Bajo Grande, Venezuela	New Refinery	35,000 bbls.	.....	Referred	.....	.....	.....	.....
Shell Co. of Venezuela	Cardon, Ven.	Comprehensive Refg.	115,000 bbls.	.....	Under Constr.	Early 1953	.....	.....	.....
Trinidad Leaseholds, Ltd.	Trinidad	Refinery addition	.....	$300,000	Designing	.....	.....	H.W.P.	H.W.P.
Europe and Africa									
*AIOC	Aden, England	New Refinery	60,000 bbls.	.....	.....	.....	.....	.....	.....
AIOC	Nuchof, Germany	Refinery Expan.	3,000 bbls.	$2.8 million	.....	End 1952	.....	.....	.....

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Anglo Iranian	Kent, England	Expansion	80,000 bbls.		Under Constr.	1953			
Anglo-Iranian Oil	Isle of Grain, Eng.	New Refinery	40,000 bbls		Under Constr.	End, 1952		Badger Div., Lummus, Kellogg	Badger Div., Lummus, Kellogg
Anglo-Iranian Oil	Kent, Eng.	Atomspheric Distill.	80,000 bbls.		Contracted	60,000—1952 80,000—1953		Badger Div.	Badger Div.
Anglo-Iranian Oil	Kent, England	Vacuum Distill.	2 x 17,000 bbls.		Contracted	Mid 53 Fall 53		Badger Div.	Badger Div.
Anglo-Iranian Oil	Kent, England	Rerun Unit	2,400 bbls.		Under Constr.				
Anglo-Iranian Oil	Kent, England	Sulfiner	5,400 bbls.		Under Constr.				
Anglo-Iranian Oil	Kent, England	Cu Chloride Treating	4 x 8,000 bbls.		Under Constr.				
Anglo-Iranian Oil	Kent, England	Acid/Soda Treat.	2,000 bbls.		Under Constr.				
Anglo-Iranian Oil	Kent, England	Propane Deasph.			Under Constr.			Kellogg	Kellogg
Anglo-Iranian Oil	Kent, England	Furfural Extrac	2,800 bbls.		Under Constr.	Fall		Lummus	Lummus
Anglo-Iranian Oil	Kent, England	MEK Dewaxing			Under Constr.	1953		Foster Wheeler	Foster Wheeler
Anglo-Iranian Oil	Kent, England	Clay Contact			Under Constr.			Lummus	Lummus
Anglo-Iranian Oil	Kent, England	Fluid Cat. Crk.	10,000 bbls.		Under Constr.	Mid 1953		Kellogg	Kellogg
Anglo-Transvaal Consolidated Investment Co.	Vall River, Union of South Africa	Synthetic Gasoline and Diesel Oil Plt.		$50-60 million	Contracted			Hydro. Res.	
Aquila, S.A.	Trieste, Italy	Prop. Deasph., Furf. Sol. Ref. MEK Dewax. Contact Filtr. Dist. & Blending Plt.	100 tons 05 U1 Lubes & Bright Stocks 8 tons all Paraffin Waxes	$7.9 million	Under Constr.		Juik, Texaco	Badger Div.	Badger Div.
Aquila, S.A.	Trieste, Italy	Lube Oil Ref.	800 bbls.	$7.9 million	Under Constr.		Juik, Texaco	Badger Div.	Badger Div.
*Bataafsche Petroleum Maatschappij	Pernis, Holland	Expansion	165,700 bbls.		Projected	Late, 1953			
Benzens & Pet. Co. of Hamburg	Hamburg-Finken, Werder, Germany	Expansion	660,000 bbls.		Announced				
William Briggs & Sons, Ltd.	Camperdown, Scotland	Crude Dist. Fac.	1,000 bbls.		Under Constr.	Early 1952			
California-Texas Oil Co.	Pernis, Netherlands	Exparding Refinery	28,000 bbls.		Under Constr.	Early 1953		Various Local	Various Local
Cie de Raffinage Shell-Berre	Berre, France	Expansion	65,000 bbls.	$31.6 million	Under Constr.	End 1953			
Cie de Raff Shell-Berre	Pauillac, France	Distilling Expansion	10,800 bbls.		Under Constr.	Late 1952			
Cie Francaise de Raffinage	La Mede, France	Cat. Crk., Gas Recov. System	11,500 bbls.	$10 million	Authorized	1953			
Cie Francaise de Raffinage	Gonfreville, France	Gas Recov. System							
Cie. Francaise de Raffinage	Gonfreville, France	Therm. Reform., Prop. Deasp., Furfl. Trtng.	4,750 bbls	$11 million	Under Constr.	1952	Texaco & Juik	Kellogg	Local
C.E.P.S.A.	Santa Cruz de Tenerife	Reforming Unit	6,000 bbls.	$1 million	Planned		U.O.P.	U.O.P.	Foster Wheeler
Condor, S.P.A. Per l'Industriale Pet. Chemica	Rho, Italy	New Refinery	27,000 bbls.		Under Constr.	1952		Badger Div.	Badger Div.
		Cat. Cracker	15,000 bbls.		Under Constr.	1952		Badger Div.	Badger Div.
Condor	Rho, Italy	Atm. Dist. Plt.	30,000 bbls.		Under Constr.	1952		Badger Div.	Badger Div.
Condor	Rho, Italy	Feed Prep.,	15,000 bbls.		Under Constr.			Badger Div.	Badger Div.
		TCC Unit	10,000 bbls		Under Constr.		Socony-Vac.	Badger Div.	Badger Div.
Condor	Rho, Italy	Recov. Purification Plt., Adm. Bldg., Pwr House			Under Constr.	1952		Badger Div.	Badger Div.
*Joseph Cromfield & Sons, Ltd.	Warrington, England	Catalyst Plt.		$3 Million	Under Constr.	End, 1952	Davison Chem.	Badger	Badger
Deutsche-Amerikanische Petro-Gesellschaft (Esso)	Hamburg-Harburg, Germany	Cracking Plt. and Expansion	8,843 bbls.	$10 million	Under Constr.	Jan., 1954		S.O.D.	Gutte-Hutte
Deutsche Erdoel, A.G.	Heide, Germany	Cracking Fac.	12,800 bbls Gas 11,250 bbls. Diese						
Deutsche Vacuum Oil A.G.	Hamburg, Germany	Cracking Unit	8,000 bbls		Under Constr.	Sept., 1952		Socony-Vac.	Gutte-Hutte
Egyptian Government	Cairo, Egypt	Crude Plt.						Lummus	Lummus
Egyptain Government	Suez, Egypt	Inc. Refn. Cap.	26,000 bbls.	$2,500,000	Planning				Lummus
Empresa Nacional	Puertollano, Spain	Shale Oil Ref.	3,000 bbls.		Under Constr.	1952			
*Esso Stand. Hatenna	Genoa, Italy	Cap. Increase							
Esso Standard Refg.	Antwerp, Belg	New Refinery Incl. Crker.	25,000 bbls.		Under Constr.	July, 1953		S.O.D.	Lummus
*Garrone	Getom, Italy	Cap. Increase							
Gewerkschaft Erdoel-Raffinerie Emsland	Near Lingen, Germany	Refinery Houdry Cat.	11,535 bbls. 7,000 bbls.	$8,670,000	Under Constr.	4th Qtr., 1952	Houdry	Lummus	Lummus
Industrie Chimiche Italiane Petrol	Mantua, Italy	Crude Ref.	4,500 bbls.		Contracted	Aug., 1952		Koch	Staff
Industria Petrolifera e Chimica	Milan, Italy	Gasoline Fuel Oil Plt.	20,000 bbls.					Dr. Calogero Inglogio	
Industria Raffinazione Oli Minerali (IROM)	Porto Marghera, Italy	Cat. Cracking Atmos. Distill. Thermal Ref.	1,400 bbls. 12,000 bbls. 6,000 bbls.	$2 million	Under Constr.			Foster Wheeler	Kellogg
Imperial Chemical Industries, Ltd.	Wilton, Yorkshire, England	Petroleum Cracking Unit	2,000 bbls.		Under Constr.			Kellogg	Kellogg
I. P. S. A.	Rotkreuz, Switz	Cat. Reformer	700 bbls.		Under Constr.	Jan., 1952	Phillips	Koch	Staff
Kali Chemie Co.	Nienberg, Germany	Head Catalyst Plt.			Licensed		So-Vac.		
Ketjen	Amsterdam, Netherlands	Synthetic Catalyst & Mfg.			Under Constr.	Early 1953			Am. Cyanamid
Manchester Oil Refinery, Ltd.	Partington, England	New Lube Refinery	30,000 bbls.		Projected				
Manchester Oil Refinery	Trafford Park, Eng.	Expansion			Under Constr.	End 1952			
Mineraloel-und Asphaltwerke, A.G.	Ostermoor, Germany	Reconstruction	1,196 bbls.						
Monsanto Chemical Co.	Britain	Add Polystyrene			Under Constr.			Staff	Staff
Montecatini Co.	Ferrara, Italy	Olefin Plt.	450 bbls.	$18.6 million	Contracted	Mid 1953		Kellogg	Kellogg
A. P. Moeller	Copenhagen, Denmark	Thermal Cracking Plt.	2,000 bbls.	$3.5 million	Field work				
National Oil Refineries, Ltd.	Llandarcy, Wales	Vacuum Unit	17,000 bbls.		Under Constr.			Badger Div.	Badger Div.
Not Known	Sidi Aissa, Fr N. Africa	Refinery (Topping plt.)	225 bbls.		Completed				Austrian Co.
N.O.R.	Llandarcy	Propane Desphalting	3,500 bbls.		Under Constr.	End, 1952	J.U.I.K.	Badger Div.	Badger Div.

• Continued on page 99

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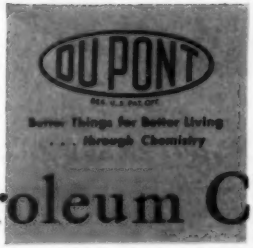

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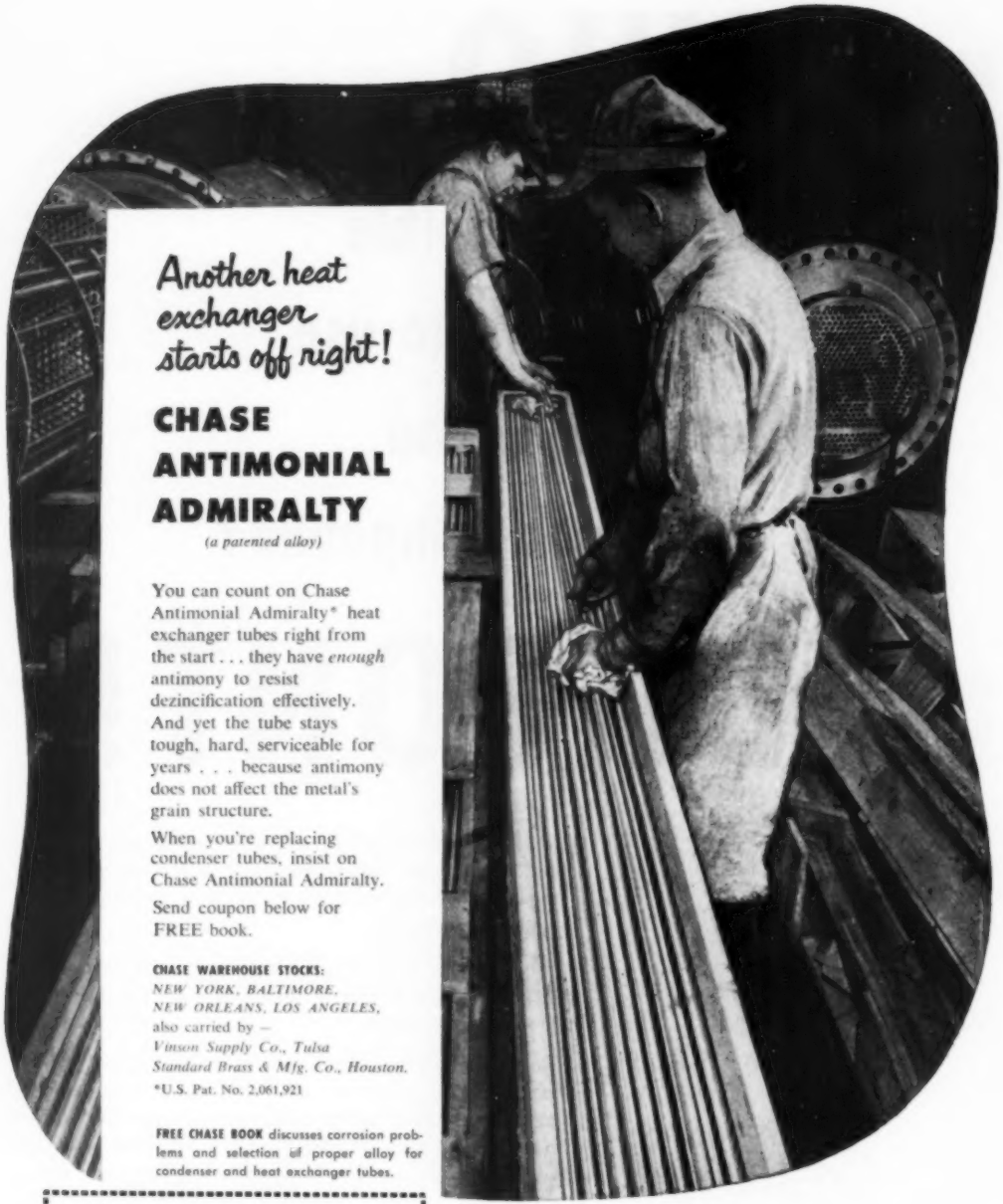

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Cincinnati	Indianapolis	New Orleans	St. Louis	

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
N.O.R.	Llandarcy	Furf. Ext.	1,250 bbls.	.....	Under Constr.	End, 1952	Texaco	Badger Div.	Badger Div.
N.O.R.	Llandarcy	M.E.K. Dewaxing	1,700 bbls.	.....	Under Constr.	End, 1952	Texaco	Badger Div.	Badger Div.
N.O.R.	Llandarcy	SO2 Kerosene Ext.	3,000 bbls	.....	Under Constr	.....	.....	H.W.P.	Staff
National Oil Refineries, Ltd.	Llandarcy, Wales	Additional Boilers	.....	.....	Under Constr.	1953	.....	Ewbank & Partners	.....
N.O.R.	Llandarcy	Generating Plant	13,000 KW	.....	Authorized	1952	.....	Ewbank & Partners	.....
N.O.R.	Llandarcy	Cat. Crk.	†0,000 bbls.	$48 million	Under Constr.	Early 1953	J.U.I.K.	Badger	Badger
A/S Norsk Amerikansk Mineraloljekompagni	Vallo, near Tonberg, Norway	Lube Oil, Asphalt	1,000 bbls.	.....					
Peehelbronn, S.A. E. M.	Merkwiller, France	Capacity Increase	1,550 bbls.	.....	Authorized	.....	.....	.....	.....
Fermolio, S.P.A., Raffinerie Italiane Olii Minerali	Genoa, Italy	TCC Unit	2,000 bbls.	$1.4 million	Under Constr.	March, 1952	Socony-Vac.	Foster Wheeler	Foster Wheeler
Permolio, S.P.A.	Milan, Italy	Perco Reforming Unit	350 bbls.	.....	Engineering	1952	Phillips	.....	.....
*Permolio	Genoa, Italy	Cap. Increase	.....	.....	.....	.....	.....	.....	.....
Permolio, S.P.A.	Rome, Italy	TCC Unit	2,000 bbls.	$1.4 million	Under Constr.	March, 1952	Socony-Vac.	Foster Wheeler	Foster Wheeler
Permolio	Milan, Italy	Furf. Sol. Ref.			Planning	1952	Stand-Tex.	Foster Wheeler	Foster Wheeler
Permolio	Milan, Italy	Prop. Deasph.	15,000 tons/yr.	.....	Planning	1952	Stand-Tex.	Foster Wheeler	Foster Wheeler
Permolio	Milan, Italy	MEK Dewax.			Planning	1952	Stand-Tex	Foster Wheeler	Foster Wheeler
Petrochemicals, Ltd.	Partington, England	Petrochemicals	2,000 bbls.	$16 million	Under Constr.	.....	Petrocarbon	Petrocarbon	Petrocarbon
Raffineries Francaises de Petrole de l'Atlantique	St. Nazaire, France	Consolidate Refineries	7,100 bbls.	$9.4 million	.....	.....	.....	Separator-Nobel	.....
Raffineries Francaises	Paris	Thermal Reformer	4,500 bbls.	.....	Under Constr.	Jan., 1952	.....	Koch	Koch
Raffinerie Siciliane Olii Minerali, Sp.A.	Augusta, Sicily	Crude Refinery	10,000 bbls.	.....	Under Constr.	.....	U.O.P.	U.O.P., Delta, Staff, Separator-Noble	Staff
Refineria de Petroleos de Escombreras, SA., (REPESA)	Escombreras Spain	Four cell induced draft cooling tower	.....	.....	Under Contract	.....	.....	.....	Foster Wheeler
REPESA	Escombreras, Spain	Crude Dist.	23,000 bbls.	$20 million	Under Constr.	Mid 1953	.....	Foster Wheeler	Foster Wheeler
REPESA	Escombreras	Thermal Reformer: Poly Cat.	8,200 bbls.	$2 million	Contracted	Fall, 1952	U.O.P.	McKee	Staff
Ruhrchemie, A.G.	Oberhausen-Holten, Germ.	Crude Refinery	6,000 bbls.	.....	Under Constr.	Mid 1952	.....	Koch	Koch
S.A. Conc. Ref. Pet. em Portugal	Cabo Riuvo Plt., Portugal	Topping Unit	10,000 bbls.	.....	.....	.....	.....	.....	.....
S.A. Conc. Ref. Pet. em Portugal	Cabo Riuvo Plt., Portugal	Cracking Unit	5,000 bbls.	.....	.....	.....	.....	.....	.....
S.A. Conc. Ref. Pet. em Portugal	Cabo Riuvo Plt., Portugal	Reformer	2,500 bbls.	.....	.....	.....	.....	.....	.....
Scottish Oils	Grangemouth, Scotland	Stage II: Cat. Crk., Gas Rec. Vac. Distill., Cat. Poly Plt., & Trting. Plt.	37,700 bbls.	$52 million	Under Constr.	Mid., 1952	U.O.P.	Kellogg	Kellogg
Shell Chemical Mfg. Co., Ltd.	Stanlow, Eng.	Teepol Plant Extension	75,000 tons per year	.....	Under Constr.	Spring, 1952	.....	.....	.....
Shell Refining & Marketing Co., Ltd.	Shell Haven, England	Reforming Unit	†10,000 bbls.	.....	Under Constr.	Early 1952	.....	.....	.....
Shell R. & M.	Shell Haven, England	Feed Prep.	†16,000 bbls.	$34 million	Under Constr.	Early 1952	.....	.....	.....
Shell R. & M.	Stanlow, Eng.	Comprehensive Refining	85,000 bbls.	.....	Under Constr.	Early 1952	.....	.....	.....
*Societe General des Huiles de Petrole	Dunkirk, France	Reconstruction of Refinery	36,000 bbls.	.....	Commissioned	.....	.....	Lummus	Lummus
		Lube Oil Plt.	.....	.....	Commissioned	.....	.....	Kellogg	Kellogg
Soc. Raff Petrole Gironde	d'Ambes, France	Capacity Expan.	16,500 bbls.	.....	Under Constr.	Mid 1952	.....	.....	.....
*Societe Industrielle Belgedes Petroles	Antwerp, Belgium	Crude Unit, vis-breake, Thermal Cracker & Reformer	30,000 bbls.	.....	Commissioned	.....	.....	Kellogg	Kellogg
Societa per l'Industria del Petrolio	La Spezia, Italy	Expansion	30,000 bbls.	.....	Under Constr.	Early 1953	.....	.....	.....
Societa per Azional Reffineria Padana Olii Minerali	Milan, Italy	Refinery	10,000 bbls.	$20 million	Planned	.....	.....	.....	.....
Societe per Anoni Raffineria Padana Olii Minerali	San Martino di Trecate, Italy	Refinery	13,300 bbls.	$15 million	Under Constr.	Sept., 1952	.....	Badger Div.	Badger Div.
Societe Raffinazione Olii Minerali (IROM)	Porto Marghera, Italy	Atmospheric & Vac. Distill., Acid Treat., Contract Filtration for Lube Oils, Electric Gen. Unit, Load Facilities	11,600 bbls.	$6.4 million	Contracted	.....	.....	.....	.....
Socony-Vacuum Francaise	Notre Dame de Gravenchon	MEK Unit	1,000 bbls.	$6 million	Under Constr.	.....	Texaco	Lummus	Staff
Socony-Vacuum Francaise	Notre Dame de Gravenchon	Grease and Compounding	900 lbs.	.....	Under Constr.	.....	.....	Staff	Staff
Socony-Vacuum Italiana, S.P.A.	Naples, Italy	Visbreaker	.....	.....	.....	.....	.....	Staff	Staff
South Africa Coal Oil & Gas	Coalbrook, Orange Free St.	Plant	3,500 bbls.	$50.4 million	Under Constr.	1955	.....	Kellogg	Kellogg
Stanic Industria Petrolifera	Leghorn, Italy	Ref. Expan.	15,500 bbls.	.....	Under Constr.	Mid 1953	.....	Staff	Staff
Standard Francaise des Petroles	Port Jerome, France	Coal Synthesis Cat. Crk. and Modernization	46,400 bbls.	$10 million	Under Constr.	June, 1953	.....	S.O.D.	Foster Wheeler
Standard Oil (N.J.)	Belgium	Dist. Crack	33,000 bbls.	.....	Planned	Early 1952	.....	.....	.....
Standard (N.J.)	Hamburg, Germany	General Expan.	32,000 bbls.	$10 million	Plan	Jan., 1954	.....	S.O.D.	Gutehoffnung-Schutte
Standard-Vacuum Ref. of South Africa	Wentworth, Durban, Union of S. Africa	Refinery	15,600 bbls.	$17 million	Under Constr.	Late 1953	.....	Foster Wheeler	Foster Wheeler
Trent Oil Prod. Development Co.	North Shields, England	Crude Plant	11,500 bbls.	$4.8 million	Plans approved	.....	.....	.....	.....

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Union Petrol Refinery, Ltd.	Johannesburg, Union of South Africa	New Refinery	.....	$20 million	Projected	.....	.....	.....	.....
*Unknown	Algiers, Algeria	Refinery	1,400 bbls.	.....	Under Constr.	.....	.....	.....	.....
Vacuum Oil Co., Ltd.	London, Eng.	Oil Refinery	6.3 mln. bbls./yr.	$28 million	Planning	.....	.....	.....	.....
Vacuum Oil Co., Ltd.	Birkenhead, England	Grease Plt.	.....	$1 million	Contracted	Early 1952	.....	H.W.P.	H.W.P.
Vacuum Oil Co.	Coryton, Eng.	Lube Refinery	17,000 bbls.	$30 million	Under Constr.	Jan., 1953	.....	Lummus	Foster Wheeler
Near East									
Anglo-Iranian	Aden, Saudi, Arabia	New Refinery	103,000 bbls.	.....	Projected	.....	.....	.....	.....
Bahrein Pet.	Bahrein	Modern. Fluid	26,000 bbls.	.....	Under Constr.	Early 1953	.....	.....	.....
Caltex	Sidon, Lebanon	Diesel, Fuel Oil Plt.	13,000 bbls.	$5.8 million	Plan	Fall, 1953	.....	.....	Staff
Consolidated Ref., Ltd.	Haifa, Palestine	Gen. Facilities Conversion of Kellogg Comb-Top. and Crk.	35,000 bbls.	.....	Planned	.....	.....	Badger Div.	.....
Iraq Government	Baghdad Area	Refinery	24,000 bbls.	$25.2 million	Contracted	Spring, 1954	.....	Kellogg	Kellogg
Israeli Government	Haifa, Palestine	Petro Chem Plt.	10 tons	$2.5 million	Under Constr.	.....	.....	.....	Staff
Turkey Government	Ramandag Field	Refinery	3,000 bbls.	$5.5 million	Planning	.....	.....	.....	.....
Far East									
Batavasche Pet. Mij. (Shell)	Balikpapan, Borneo, East Indies	Expansion	44,000 bbls.	.....	Under Constr.	Early, 1955	.....	.....	.....
Batavasche Pet. Mij.	Pladjoe, Sumatra	Rehad. to Comprehensive Refg.	71,000 bbls.	.....	Under Constr.	Early 1952	.....	.....	.....
Batavasche Pet. Mij.	Tjepu, Java	Rebuild TEL Blending Unit & Dist. Unit	.....	.....	Planning	.....	.....	.....	.....
Burmah Oil Co., Ltd.	Syriam, Burma	Furf. Sol. De-wax., Wax Mfg.	1,000 bbls.	$600,000	Designing	.....	Texaco	Badger Div.	.....
Burmah Oil (Rangoon)	Chaukfield, Burma	2 Stage Distillation & Related Fac.	3,000 bbls.	Salvage	Under Constr.	Dec., 1952	.....	Staff	Staff
Burmah Shell	Bombay, India	Refinery	20,000 bbls.	$47 million	Under Constr.	1956	.....	.....	.....
Caltex	India	.....	20,000 bbls.	.....	Plan	.....	.....	.....	.....
Caltex	Viragapatam, India	Refinery	.....	.....	Expected	.....	.....	.....	.....
N. V. Curacaosche Petroleum	Curacao Netherlands, Antilles	Lube Ref. Ext.	2,000 bbls.	.....	Under Constr.	Early 1954	.....	.....	.....
KOA Oil Co., Ltd. (and)	Marifu, Japan	Expansion of Vac. Unit, Contact Rerun Unit	Restricted to 8,000 BPCD	.....	Under Constr.	.....	.....	Chiyoda	Chiyoda
Caltex Oil Co., Ltd. Koppers Co.	India	2 Coal Hydrogenation Plts.	70,000 tons	.....	Announced	.....	.....	.....	.....
Kao Oil Co., Ltd.	Marifu, Japan	Modern. Plat.	10,000 bbls.	.....	Under Constr.	April, 1952	.....	Chiyoda	Chiyoda
			1,300 bbls.		Engineering	Oct., 1953			
Mitsubish Oil Co., Ltd.	Tokye, Japan	Vacuum Distillation Unit	2,000 bbls.	.....	.....	.....	.....	.....	.....
Mitsubishi Oil	Tokyo, Japan	Solvent Extraction & Dewaxing Processes	.....	.....	.....	.....	.....	.....	.....
Nippon Oil Co., Ltd.	Yokohama, Japan	Modern. and Expansion	12,000 bbls.	.....	Under Constr.	July, 1954	.....	.....	.....
Nippon Oil	Kudamatsu, Japan	Modern. Plat. Unit	7,000 bbls.	.....	Under Constr.	End 1952	.....	.....	.....
			1,300 bbls.		Engineering	Oct., 1953			
Nippon Oil	Japan	Lube Oil Refining	.....	.....	Under Constr.	.....	.....	Separator-Nobel	.....
Standard-Vacuum	Bombay, India	Refinery	25,000 bbls.	$35 million	Under Constr.	1956	.....	Staff	Lummus
Stan-Vac	Bombay, India	.....	20,000 bbls.	$35 million	Plan	.....	.....	.....	.....
Toa Nenryo Kogyo K. K.	Wakayama, Japan	Propane, Dewaxing	1,200 bbls.	.....	Under Constr.	Oct., 1952	.....	S.O.D.-Staff	Staff
T. N. K.	Wakayama	Phenol Ext.	1,720 bbls.	.....	Under Constr.	Oct., 1952	.....	S.O.D.-Staff	Staff
Oceania									
AIOC	Fremantle, Australia	Refinery	70,000 bbls.	$90 Million	Planned	.....	.....	.....	.....
Anglo-Iranian	Victoria, Australia	Refinery or Expansion	55-85,000 bbls.	$66-90 million	Considering	.....	.....	.....	.....
Australian Shell	Clyde, New South Wales	LVI Lube Oil	250 bbls.	$620,000	Under Constr.	Early, 1953	.....	.....	.....
Australian Shell Oil Co.	Geelong, Victoria, Australia	New Refinery	26,000 bbls.	$12 million	Under Consid.	Late 1954	.....	.....	.....
Australian Shell	Geelong, Victoria, Australia	Bitumen and Laboil Plant	.....	$10 million	Projected	Late 1953	.....	.....	.....
Australian Shell	Geelong, Victoria, Australia	Asphalt, Lube Sol. Extct Plt.	.....	.....	Projected	Late 1953	.....	.....	.....
Australian Shell	Melbourne, Australia	New Refinery	22,000 bbls.	.....	Under Constr.	Fall, 1953	.....	.....	.....
Bitumen & Oil Ref.	Matraville (NSW) Aust.	Platforming Unit	1,500 bbls.	$900,000	Complete	.....	.....	.....	.....
Caltex	Sydney, Australia	Refinery	22,000 bbls.	$56 million	Engineering	Jan., 1955	.....	.....	.....
Caltex	Manila, P.I.	Refinery	13,000 bbls.	$30 Million	Engineering	July, 1954	.....	.....	.....
Vacuum Oil Co.	Altona, Aust.	Refinery	20,000 bbls.	$30 million	Planned	1955	.....	.....	.....

* First appearance in tabulation. † Added capacity.

NOTE: Atlantic—Atlantic Ref. Co. Austin—Austin Co. Badger Div.—Stone & Webster Engineering Co. Bechtel—Bechtel Corp. Blaw—Blaw-Knox Construction Co. Braun—C. F. Braun Co. Brown & Root—Brown & Root Construction Co. Can. Kellogg—Canadian Kellogg Co. Cat. Constr.—Catalytic Construction Co. Chemico—Chemical Construction Co. C.B. & I.—Chicago Bridge & Iron Works Co. Chiyoda—Chiyoda Chemical Engineering & Constr. Co., Ltd. Consd. Eng.—Consolidated Engineering Co. D & Z—Day & Zimmermann. Delta—Delta Engineering Corp. Dresser—Dresser Engineering Corp. Ebasco—Ebasco Services, Inc. E&A—Ehrhart & Arthur, Inc. Ferguson—H. K. Ferguson Co. Fluor—Fluor Corp. Gas Plant Constr.—Gasoline Plant Construction Corp. Graff—Graff Engineering & Equipment. Gutte-Hutte—Gutte Hofnungs Hutte. Hercules—Hercules Powder Co. Hudson—Hudson Engineering Corp. H.W.P.—Head Wrightson Process, Ltd. Hydrocarbon—Hydrocarbon Research, Inc. Kellogg—The M.W. Kellogg Co. Kellogg P. A.—Kellogg Pan-American. Koch—Koch Engineering Co. Koppers—Koppers Co., Inc. Lummus—The Lummus Co. Macco—Macco Corp. McKee—Arthur G. McKee Co. O. L. Olson. P. A. HydroRes—Pan-American Hydrocarbon Research Co. Parker—Parker, Steffens, & Pearse. Parsons—The Ralph M. Parsons Co. Petco—Petroleum Engineering Tool Co. Phillips—Phillips Petroleum Co. Pritchard—J. H. Pritchard Co. Procon—Process Construction, Inc. Ref. Eng.—Refinery Engineering Co. Separator-Nobel Co. Socony-Vac.—Socony-Vacuum Oil Co. Southwestern—Southwestern Constr. Co. S.O.D.—Standard Oil Development Co. Sohio—Standard Oil Co. of Ohio. Stearns-Roger—Stearns-Roger Manufacturing Co. Stone & Webster—Stone & Webster Construction Co. Sunland—Sunland Refining Co. Sweco—Southwestern Engineering Co. Tears—Tears Engineers. Texaco—The Texas Co. U.O.P.—Universal Oil Products Co. J. G. White—J. G. White Eng. Corp.

BRIDGEPORT BRASS COMPANY
CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

"Bridgeport" MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Safety and Efficiency Through Corrosion Inspection, Maintenance

Corrosion must be dealt with realistically because of its effect on safety, production and efficiency. This explains the vital importance of corrosion engineering in the petroleum refining industry.

A serious corrosion offender is water circulated by the millions of gallons for cooling purposes. Contamination may increase or decrease the corrosiveness of the water depending on temperature and other conditions. In most cases, the proper copper-base alloys can be successfully used to advantage. With suitable metals and good operating practice, corrosion can be kept within bounds.

Steel Clad With Brass

Raw liquid gasoline and vapors in crude fractionation and in thermal and catalytic cracking are sometimes very corrosive to steel, especially where the temperature is such that the water content is in the liquid phase.

Experimentation by Sun Oil Company showed that various high-zinc brasses—yellow brass, Muntz metal, naval and Admiralty—are much more resistant than steel to corrosion by sulfur compounds such as hydrogen sulfide, mercaptans, etc. Realizing that brass alone would not provide the maximum safety in case of fire, they lined with brass the pipes, fittings and the steel vessel nozzles in the wet gas, gasoline and water separators of such units. Joints were made by brazing or welding and machined smooth to minimize impingement type corrosion due to turbulence.

Steel was not allowed to come into contact with the raw gasoline containing small amounts of water in order to avoid galvanic attack. It was also necessary to have steel backing up the brass in cases where ammonia was present due to the possibility of season cracking. Some of these brass-lined installations have already been in service for ten years.

In addition, the use of bimetal tubes and non-ferrous linings simplify shut down inspection because it is known from experience that the corrosion rates are low and therefore it is not necessary to open such equipment every shut down.

Galvanic Corrosion Dangerous

No piece of equipment or part is too small to be overlooked from a safety standpoint. Even the failure of a small plug in a pump case opening can cause a serious fire. For example, steel or iron plugs in a brass or bronze or monel metal pump carrying a corrosive liquid may cause the ferrous plug to fail rapidly from galvanic corrosion. On the other hand, a brass plug in a ferrous pump is much less apt to give trouble. This illustrates the fact that the proper material must be used in the proper place.

In Sun Oil Company's square condensers, the steel baffle plates, which are attached to the doors, were originally designed to be separated from the brass tube sheets by means of fiber gaskets. In a short time the ends of the baffles were seriously corroded permitting the water to by-pass some of the tubes. By cutting back the front end of the baffles and welding a section of brass for direct contact with the tube sheet, galvanic attack was stopped.

Temperature Control Important

Sun Oil Company, in addition to river water, generally uses circulating water which is cooled and reclaimed. However, during hot weather, increased water temperatures cause appreciable rise in tube-wall temperatures and has a pronounced effect on corrosion rates.

Condensers and heat exchangers, containing Admiralty and Cupro Nickel tubes are given a thorough cleaning at the beginning of the warm season for more efficient operation. The product side which builds up an insulating coating on the outside of the tubes is thoroughly cleaned with a 10 per cent solution of trisodium-phosphate heated to boiling by live steam. During this cleaning operation the inside of the tube, or water side, dries out and the deposit of silt and slime becomes a dry powder which flakes off easily and can be blown out by compressed air.

Preventive Maintenance

Sun Oil Company believes in preventive maintenance. Corrosion engineers are trained to take charge of certain units for the purpose of keeping an accurate record on the life of the tubing, pipelines and equipment, and to observe any deviation from established safe working conditions. They look for such troublemakers as thinning by corrosion, erosion or oxidatio fouling, breakages, bulging and pitting

All equipment is inspected and gauged after a definite period of operation to make sure that the metal thickness conforms to their established factors of safety. Continuous records on the temperature changes on the product side and the cooling water indicate when the efficiency drop makes it necessary to shut down for cleaning the tubes. This practice of keeping temperatures as low as possible has a beneficial effect in keeping corrosion attack at a minimum.

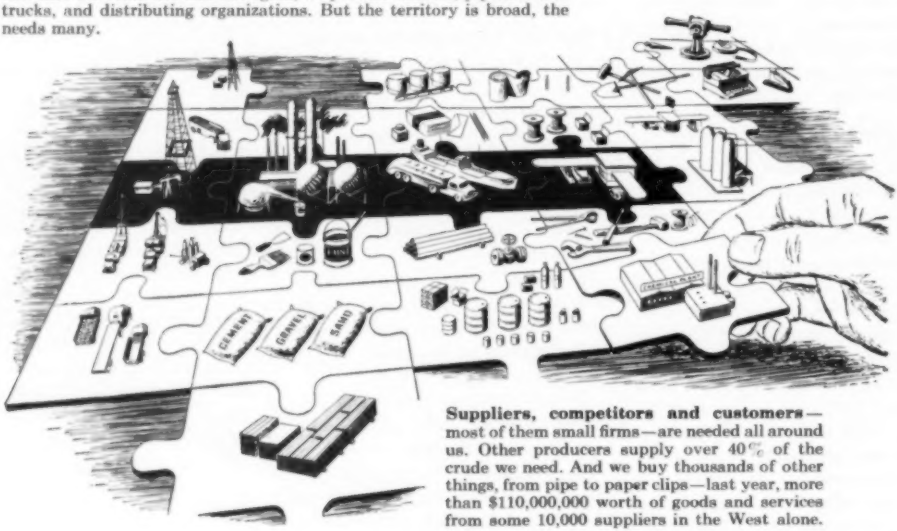
Bridgeport's corrosion laboratory service is available to help operators of condensers and heat exchangers select the copper-base alloys which will serve best. (8592)

"How can small firms hold their own with a big company like you?"

Men who run small businesses *have said such things as: "Some people think we're being frozen out. I'm doing well, but what about others? How can small firms hold their own with a big company like you?"*

You can see the answer for yourself when you get a clear picture of the way business firms depend upon one another. Even a big, integrated company can't stand alone.

Our company is a number of parts that fit together like pieces of a jigsaw puzzle. At the center of things, we're refiners. Then to be sure of a supply of crude oil, we drill wells of our own. And to keep up the flow into our refineries and out again, we provide tankers, pipelines and trucks, and distributing organizations. But the territory is broad, the needs many.



Suppliers, competitors and customers—most of them small firms—are needed all around us. Other producers supply over 40% of the crude we need. And we buy thousands of other things, from pipe to paper clips—last year, more than $110,000,000 worth of goods and services from some 10,000 suppliers in the West alone.

There are many small refiners competing with us. In every field, there are distributors selling either our products for us or competitive lines. For example, here in the West—independent service stations selling our gasoline outnumber Company-owned stations about six to one . . . and stations selling other brands outnumber our own about 29 to one.

These small firms "hold their own" very well indeed; and through serving well, many of them will grow big. Standard goes right on working to gain new business—competing for your patronage by increasing efficiency of operation, improving products, keeping prices down. But it's clear that a vast number of small firms, too, *always* will be needed to complete the picture.

STANDARD OIL COMPANY OF CALIFORNIA

• plans ahead to serve you better

Fractionation Calculations Made Easier and Faster

The method also may be used to determine the location of the feed plate

E. N. PENNINGTON, F. H. POETMANN and K. H. HACHMUTH
Phillips Petroleum Company, Bartlesville, Okla.

THIS new method developed for fractionation calculations saves considerable time and effort. Based on the usual assumptions of constant molal overflow and constant relative volatility, it is applied here to the solution of multicomponent fractionation problems and the results compare favorably with those of the more rigorous stepwise method. It is possible by this method to obtain a solution, or even a series of acceptable solutions, to a multicomponent fractionation problem with a minimum of time and effort. The solution requires only one trial and error bubble-point calculation and very little other auxiliary calculations.

The method has the advantage over other somewhat similar methods in being based on a more rigorous derivation. If the average volatility ratios are used for each section of the column, this correlation is capable of approximating the location of the feed entry. It may also be used as an aid in determining the concentration of components, other than the key components, in the vicinity of the feed tray. In this respect it is a convenient tool in making the first approximation for more rigorous methods of calculations if such solutions are desirable.

Since Sorel[10] introduced his method of fractionation calculations in 1889 there has been continual search for shorter and simpler methods of calculation. Such methods of calculation are desirable to reduce the time devoted to design calculations and to eliminate the tediousness of lengthy trial and error calculations which are inherent to most methods. Also it is frequently desirable to have a reasonably accurate answer to fractionation design problems in a matter of hours rather than days.

In the search for shorter and simpler methods of calculation there have been certain notable milestones. Among these are the graphical methods introduced by Ponchon,[9] and McCabe and Thiele.[8] These methods are limited to binary systems but by various means have been modified to give approximate solutions for multicomponent systems. These methods have also served as the basis for the development of yet other methods such as those proposed by Jenny[7] and Hengstebeck.[6]

Probably the simplest and shortest solutions are those based on graphical correlations of data determined by various means of rigorous calculations. Three such methods have been proposed, one by Brown and Martin,[1] one by Gilliland,[4] and one by Hachmuth.[5] All of these methods are correlations of data calculated mainly for binary systems but also include some multicomponent data and are said to be applicable to multicomponent systems. These methods have the shortcoming of not locating the feed entry. In addition the Brown-Martin method uses the minimum number of equilibrium steps as a parameter. It has been found that the minimum number of equilibrium steps is not a true parameter of such a correlation. Other methods of calculation require considerable auxiliary calculations or the construction of diagrams for each problem which eliminates them from the "short and simple" classification. A more detailed description of these and other methods of calculation is given by Edmister.[2]

The purpose of this article is to present a graphical correlation of data and to demonstrate its application to fractionation design problems for both binary and multicomponent systems.

Development of Correlation

Even the most rigorous of fractionation calculations are based on certain assumptions and any method capable of giving a solution in a short time with a minimum of effort must be based on certain additional simplifying assumptions. Therefore, the following assumptions have been made in the development of the correlation herein presented:

1) Constant volatility ratio over the composition range of the desired separation.

2) Constant molal overflow, i.e., all components present have the same molal heat of vaporization, the change in sensible heat of the materials over the temperature range considered is negligible, the heat of mixing of the components is negligible, and heat losses are negligible.

3) The vapor leaving each step is in equilibrium with the liquid leaving the same step.

The limits of any fractionation design are minimum equilibrium steps at total reflux and infinite equilibrium steps at minimum reflux. These limiting conditions are always a practical consideration in any fractionation design solution and are a necessary consideration in any empirical correlation such as the one being presented. The minimum number of equilibrium steps were calculated from the Fenske[3] equation

$$N_m = \frac{\log \dfrac{x_{1B}\,(1 - x_{1D})}{x_{1D}\,(1 - x_{1B})}}{\log \alpha} \qquad (1)$$

The minimum reflux or the equivalent liquid to vapor ratio is calculated by the McCabe-Thiele method

$$\left(\frac{L}{V}\right)_m = \frac{y_{1B}^* - x_{1D}}{x_{1B} - x_{1D}} \qquad (2a)$$

for the stripping section or

$$\left(\frac{L}{V}\right)_m = \frac{x_{1D} - y_{1D}}{x_{1D} - x_{1B}^*} \qquad (2b)$$

for the absorption section.

The data for the intermediate conditions were calculated by the McCabe-Thiele method or an analytical expression which is in good agreement with the McCabe-Thiele method. The number of equilibrium steps for each of the two sections of the fractionator were determined independently.

The number of equilibrium steps required to effect a given separation between two components is a function of the relative volatility ratio, the liquid to vapor ratio, and three compositions. Thus

$$N = f\left(\alpha, \frac{L}{V}, x_F, x_D, x_B\right) \qquad (3)$$

Since it is not possible to represent all the variables in one graphical correlation some of the variables must be eliminated or combined. Either x_B or x_D may be eliminated by considering the separation to be effected in two sections of a column. Thus

$$N_B = f\left(\alpha, \frac{L}{V}, x_F, x_B\right) \qquad (4a)$$

and

$$N_A = f\left(\alpha, \frac{L}{V}, x_F, x_D\right) \qquad (4b)$$

The effect of the relative volatility ratio may be eliminated by considering the ratio of some unknown intermediate condition to the limiting conditions. Thus

$$(N_m/N_a)_S = f\left[\left(\frac{L}{V}\right)_a \Big/ \left(\frac{L}{V}\right)_m, x_F, x_B\right] \quad (5a)$$

$$(N_m/N_a)_A = f\left[\left(\frac{L}{V}\right)_a \Big/ \left(\frac{L}{V}\right)_m, x_F, x_D\right] \quad (5b)$$

Then finally the two composition variables in each case may be combined to form a paramater, P, and the L/V function may be designated by a ratio, R.

$$(N_m/N_a)_S = f(R_S, P_S) \quad (6a)$$

$$(N_m/N_a)_A = f(R_A, P_A) \quad (6b)$$

Although the parameter and the L/V function may each be a complex function the problem is now effectively expressed in terms of three variables which may be represented by a family of curves on at most two charts; one chart for Equation (6a) and one for Equation (6b).

Considering the equilibrium curve of a binary system having a constant volatility ratio, Figure 1, it is seen that the curve is symmetrical. Thus it is possible by proper choice of functions for L/V and P to make identical solutions for similar separations at either end of the equilibrium curve. The following functions have been empirically derived:

$$R_S = \left[\left(\frac{L}{L-V}\right)_m \Big/ \left(\frac{L}{L-V}\right)_a\right]_S \quad (7a)$$

$$R_A = \left[\left(\frac{V}{V-L}\right)_m \Big/ \left(\frac{V}{V-L}\right)_a\right]_A \quad (7b)$$

$$P_S = 0.400 + (0.600 - \frac{1-x_{1F}}{1-x_{1B}})\left[0.591 - 0.546\left(\frac{x_{1B}}{x_{1F}}\right)^{0.5}\right] \quad (8a)$$

$$P_A = 0.400 + (0.600 - \frac{y_{1F}}{y_{1D}})\left[0.591 - 0.546\left(\frac{1-y_{1D}}{1-y_{1F}}\right)^{0.5}\right] \quad (8b)$$

These equations were derived by looking to the liquid phase in the stripper and to the vapor phase in the absorber.

Since (7a) equals (7b) and (8a) equals (8b) numerically for symmetrical solutions the final correlation may be a family of curves on one chart as shown in Figure 2. This figure is a correlation of calculated data with the ratio *R* as defined above plotted versus the ratio N_m/N_a with the function *P* serving as parameter.

The correlation applies to any system to which the basic assumptions are applicable. It is not essential that the assumptions apply strictly to the system as limited deviations from the assumptions will not cause serious error. The correlation covers the full range of operating conditions from minimum to infinite equilibrium steps or from total to minimum reflux. It covers a sufficiently wide range of compositions to permit its application to most practical problems.

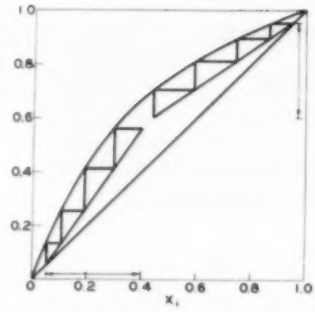


Figure 1. Symmetry of McCabe-Thiele Diagram.

The correlation was made on the basis of data calculated from binary systems at constant volatility ratio and constant molal overflow and is thus a true representation of such systems. However, to the extent that the solution of a multicomponent system may be approximated by considering the key components as a binary system, this correlation may be applied to multicomponent systems. It may further be applied to multicomponent systems to aid in the estimation of the concentrations of components other than the key components in the vicinity of the feed plate. However, such an estimation can be made only by trial and error.

A more direct method of estimating the concentrations at the feed entry is possible if the number of equilibrium steps estimated by the correlation for the separation between the key components is great enough to be considered an infinite number for the separation with respect to the other components. If it is assumed that the concentration of a component does not change between two adjacent equilibrium steps, which is the case when the number of steps becomes infinite, the following equations may be derived:

$$\frac{x_{1B}}{x_{1M}} = \left(\frac{L}{L-V}\right)\left(\frac{\alpha-1}{\alpha}\right) + \frac{1}{\alpha}\frac{x_{1B}}{x_{1M}} \quad (9)$$

$$\frac{x_{1D}}{x_{1M}} = \alpha\frac{x_{1D}}{x_{1M}} + (1-\alpha)\left(\frac{L}{L-V}\right) \quad (10)$$

Equation (9) may be used to estimate the concentration at the feed entry of components heavier than the heavy key component. Equation (10) may be used to estimate the concentration at the feed entry of components lighter than the light key component.

In general there are two types of fractionation process design problems. First, there is the problem of determining the number of equilibrium steps and the heat load or reflux ratio required to effect a given separation. Second, there is the problem of determining if an existing fractionator is capable of effecting a desired separation. This correlation may be used to solve either problem.

Generally, in a fractionation design problem it is required that the number of equilibrium steps and the corresponding heat load or flow ratio is needed to effect the desired separation be determined. Briefly, the solution is obtained as follows: Determine the relative volatility ratio of the key components, the minimum liquid to vapor ratio in each section of the fractionator, the minimum equilibrium steps to effect the separation between the key components in each section of the column, and the parameter, *P*, for each section as defined by Equations (8a) and (8b). Select related values for *R* as defined by Equations (7a) and (7b). Read from Figure 2 the corresponding values of the ratio N_m/N_a.

NOMENCLATURE

- L moles liquid phase passing a given point per unit time
- N number of equilibrium steps
- P parameter defined by Equations (8a) and (8b)
- R ratio defined by Equations (7a) and (7b)
- V moles vapor phase passing a given point per unit time
- x mole fraction any component in liquid phase
- y mole fraction any component in vapor phase
- * denotes vapor in equilibrium with liquid at indicated place in fractionator, or liquid in equilibrium with vapor. Thus y_n^* is composition of vapor in equilibrium with liquid leaving *n*th equilibrium step.

Subscripts

- A pertains to absorbing section or section above feed entry
- a denotes actual conditions or conditions intermediate to limiting conditions
- B pertains to bottom product
- D pertains to top product
- F pertains to feed
- i indicates more volatile component of a binary system
- j indicates less volatile component of a binary system
- M pertains to mid-portion of fractionator when concentration does not change from step to step
- m denotes limiting conditions either maximum or minimum
- S pertains to stripping section or section below feed entry
- 0---n indicates equilibrium step number. Numbering from bottom to top of fractionator.

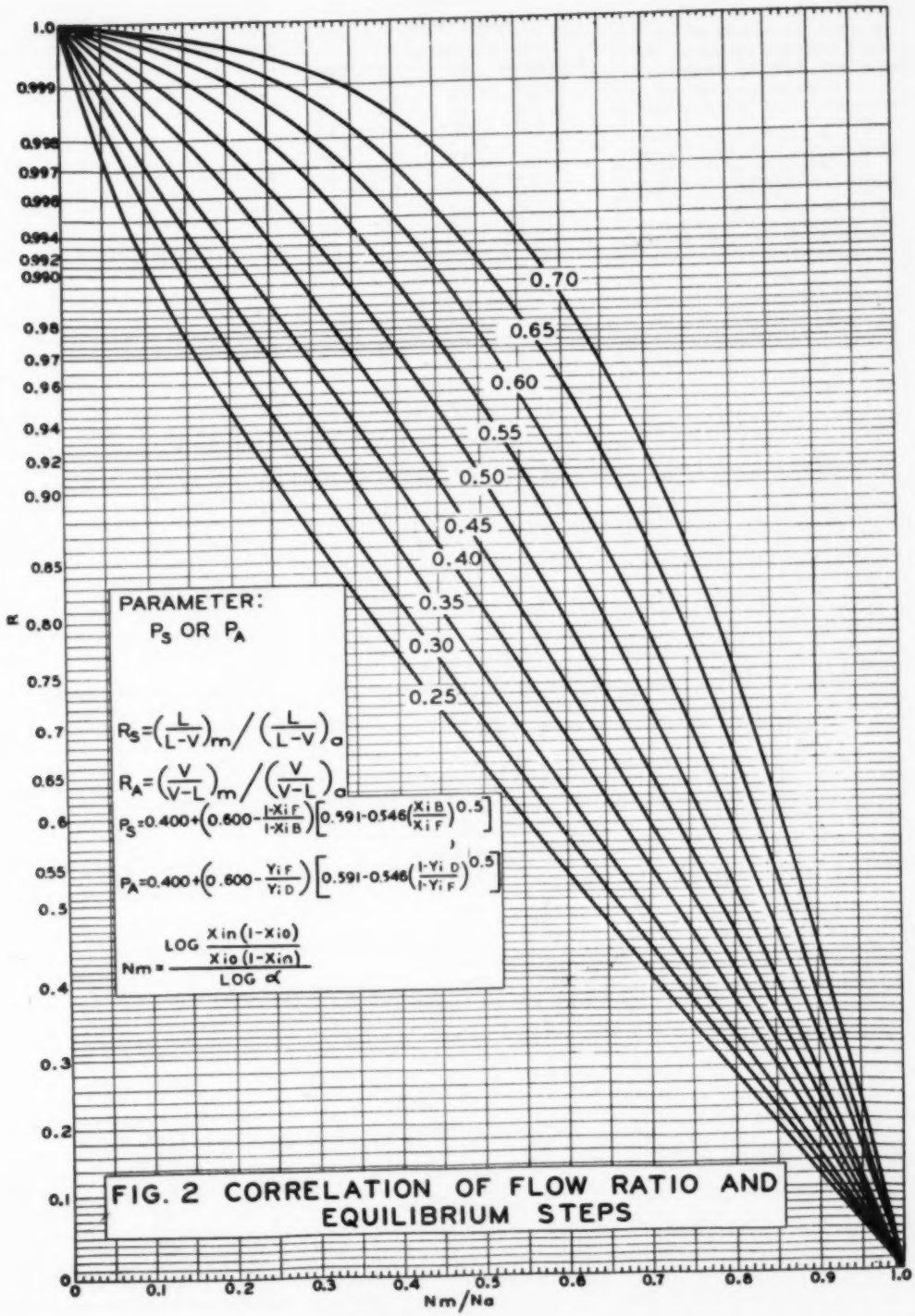


FIG. 2 CORRELATION OF FLOW RATIO AND EQUILIBRIUM STEPS

Calculate the values of N for each section of the fractionator.

In detail the solution of the first problem outlined above may be determined in the following manner:

1) Set down in terms of moles the composition of the feed and top and bottom products.

2) Calculate the bubble point temperature of the feed at the desired pressure.

3) Determine the relative volatility of the light key component with respect to the heavy key component at the bubble point temperature of the feed.

4) Considering the key components as a binary pair, determine the concentrations of the two components in the feed and the two products.

5) Calculate the composition of the vapor in equilibrium with the binary feed.

$$y_i^* = \frac{\alpha x_i}{1 + x_i(\alpha - 1)} \qquad (11)$$

6) Determine the minimum number of equilibrium steps in the stripper by Equation (1)

$$N_m = \frac{\log \dfrac{x_{iF}(1 - x_{iB})}{x_{iB}(1 - x_{iF})}}{\log \alpha}$$

7) Calculate the value of the parameter from Equation (8a).

8) Choose a value for R. This choice may be arbitrary and several choices may be used to study a range of operating conditions. A value around 0.9 will probably give the most practical solution.

9) Read from Figure 2 the value of N_m/N_s corresponding to the value of P calculated in step 7 and the value of R chosen in step 8.

10) The number of equilibrium steps in the stripper is the minimum number divided by the ratio N_m/N_s.

11) Determine the limiting liquid to vapor ratio for the stripping section by Equation (2a). In this case the limiting ratio is a maximum. Also

$$\left(\frac{L}{L-V}\right)_m = \frac{1}{1 - 1/\left(\frac{L}{V}\right)_m} \qquad (12)$$

12) Determine $\left(\frac{L}{L-V}\right)_s$ from Equation (7a) also

$$\left(\frac{L}{V}\right)_s = \frac{1}{1 - 1/\left(\frac{L}{L-V}\right)_s} \qquad (13)$$

13) Assuming the feed enters as a liquid at its boiling point, find the y intercept of the operating line and $x_i = x_{iF}$.

$$y_{iF} = \frac{L}{V}(x_{iF} - x_{iB}) + x_{iB} \qquad (14)$$

14) Determine $(L/V)_s$ for the absorber by

$$\left(\frac{L}{V}\right)_s = \frac{x_{iD} - y_{iF}}{x_{iD} - x_{iF}} \qquad (15)$$

and

$$\left(\frac{V}{V-L}\right)_s = \frac{1}{1 - \left(\frac{L}{V}\right)_s} \qquad (16)$$

15) Determine $(L/V)_m$ for the absorber by Equation (2b) where

$$x_i^* = \frac{y}{\alpha + y(1 - \alpha)} \qquad (17)$$

In this case the limiting ratio is a minimum. And

$$\left(\frac{V}{V-L}\right)_m = \frac{1}{1 - \left(\frac{L}{V}\right)_m} \qquad (18)$$

TABLE 1

Sample Calculation

Step	Component	Feed	Distillate	Bottoms
1	C_2H_6	0.11	0.11	
	C_3H_8	11.15	11.00	0.15
	iC_4H_{10}	8.29	0.05	8.24
	nC_4H_{10}	25.00	.....	25.00
	iC_5H_{12}	0.11	.....	0.11
		44.66	11.16	33.50
2	Component	Feed	K_{150}	KX
	C_2H_6	0.11	3.42	0.38
	C_3H_8	11.15	1.64	18.29
	iC_4H_{10}	8.29	0.94	7.79
	nC_4H_{10}	25.00	0.73	18.25
	iC_5H_{12}	0.11	0.42	0.05
		44.66		44.76
3	$T = 190°F.$ $\alpha = 1.64/0.94 = 1.75$			
4	Component	xF	xD	xB
	C_4H_{10}	0.5736	0.9955	0.0179
	iC_4H_{10}	0.4264	0.0045	0.9821
5	$Y_{iF}^* = \dfrac{1.75 \times 0.5736}{1 + 0.75 \times 0.5736} = 0.7019$			
6	$N_{mS} = \dfrac{\log \frac{0.5736 \times 0.9821}{0.0179 \times 0.4264}}{\log 1.75} = 7.69$			
7	$P_S = 0.400 + (0.600 - \frac{0.4264}{0.9821})\left[0.591 - 0.546\left(\frac{0.0179}{0.5736}\right)^{\frac{1}{2}}\right] = 0.482$			
8	$R_S = 0.9$			
9	$N_m/N_s = 0.491$			
10	$N_{sS} = 7.69/0.491 = 15.7$			
11	$(L/V)_m = \dfrac{0.7019 - 0.0179}{0.5736 - 0.0179} = 1.2309$; $\left(\frac{L}{L-V}\right)_m = 5.330$			
12	$\left(\frac{L}{L-V}\right)_s = 5.330/0.9 = 5.922$; $(LV)_s = 1.2032$			
13	$y_{iF} = 1.2032(0.5736 - 0.0179) + 0.0179 = 0.6865$			
14	$(L/V)_s = \dfrac{0.9955 - 0.6865}{0.9955 - 0.5736} = 0.7324$; $\left(\frac{V}{V-L}\right)_s = 3.7369$			
15	$x_{iF}^* = \dfrac{0.6865}{1.75 - 0.6865 \times 0.75} = 0.5558$; $(L/V)_m = \dfrac{0.9955 - 0.6865}{0.9955 - 0.5558} = 0.7028$; $\left(\frac{V}{V-L}\right)_m = 3.3647$			
16	$R_A = 3.3647/3.7369 = 0.9004$			
17	$P_A = 0.400 + \left(0.600 - \frac{0.6865}{0.9955}\right)\left[0.391 - 0.546\left(\frac{1 - 0.9955}{1 - 0.6865}\right)^{\frac{1}{2}}\right] = 0.353$			
18	$N_{sA} = \dfrac{\log \frac{0.9955 \times 0.2135}{0.6865 \times 0.0045}}{\log 1.75} = 8.25$			
19	$N_m/N_s = 0.358$			
20	$N_{sA} = 8.25/0.358 = 23.0$			

16) Calculate R_A from Equation (7b).

17) Calculate P_A from Equation (8b).

18) Determine minimum number of equilibrium steps in absorber by Equation (1)

$$N_m = \frac{\log \dfrac{y_{iD}(1 - y_{iF})}{y_{iF}(1 - y_{iD})}}{\log \alpha}$$

19) Using values of R and P from steps 16 and 17 respectively, find ratio N_m/N_s from Figure 2.

20) The number of equilibrium steps in the absorber is the minimum number divided by the ratio N_m/N_s from step 19.

21) The heat load and condenser load may be calculated from the usual heat and material balances.

A sample solution is shown in Table 1.

The solution of the second type of design problem, i.e., to determine if an existing fractionator is adequate for a desired separation, is solved in a similar manner. A series of solutions as described above are obtained and the equilibrium steps are plotted versus reflux ratio. Then considering the number of plates in the column and the expected plate efficiency determine the equilibrium steps available, and considering the capacity of the fractionator determine the allowable reflux ratio. Plot this point on the plot of equilibrium steps versus reflux ratio. If the point falls above the curve the fractionator is adequate. If it falls below the curve the fractionator is not adequate.

If desirable the composition of the liquid on the plate immediately below the feed entry may be estimated by Equations (9) and (10). This may be done by the following procedure:

1) Consider each of the components heavier than the key components in turn with the heavy key component, and each

TABLE 2

Concentrations at Feed Entry

Sample Calculation

Step				
1	iC_4-nC_4	$\alpha = 0.936/0.726 = 1.29$		
	iC_4-iC_5	$\alpha = 0.936/0.416 = 2.25$		
	C_2-C_3	$\alpha = 3.42/1.64 = 2.09$		
2	$\left(\frac{L}{L-V}\right)_s = 5.922$ $\left(\frac{L}{L-V}\right)_s = -2.737$			
3	$x_{iB}/x_{iM} = 0.2460/0.1856 = 1.325$; $x_{iD}/x_{iM} = 0.9836/0.2497 = 3.947$			
4	nC_4 $x_{iB}/x_{iM} = 5.922\left(\frac{0.29}{1.29}\right) + \frac{1.325}{1.29} = 1.584$			
	iC_5 $x_{iD}/x_{iM} = 5.922\left(\frac{1.25}{2.25}\right) + \frac{1.325}{2.25} = 3.879$			
	C_2 $x_{iD}/x_{iM} = 2.09 \times 3.947 + 1.09 \times 2.737 = 11.232$			
5	nC_4 $x_{iM} = 0.7462/1.584 = 0.4712$			
	iC_5 $x_{iM} = 0.0033/3.879 = 0.0008$			
	C_2 $x_{iD} = 0.0099/11.232 = 0.0009$			
6		x (Calc.)	x (Adjusted)	Calculated By Stepwise
	C_2	0.0009	0.0010	0.0001
	C_3	0.2497	0.2749	0.2739
	iC_4	0.1856	0.2044	0.2481
	nC_4	0.4712	0.5188	0.4765
	iC_5	0.0008	0.0009	0.0014
		0.9082	1.0000	1.0000

of the components lighter than the key components with the light key component. Determine the relative volatility ratio of each pair.

2) Use the value of $\frac{L}{L-V}$ calculated in step 12 above for the stripping section and convert the value of L/V from step 14 above to a value of $\frac{L}{L-V}$ for the absorbing section.

3) Use the concentrations of the heavy key component in the feed and the bottom product to determine the ratio x_{iB}/x_{iM}. Use the concentration of the light key component in the feed and the distillate to determine the ratio x_{iD}/x_{iM}.

4) Substitute the values from steps 1, 2, and 3 into equations (9) and (10) to calculate the ratios x_{iB}/x_{iM} for the heavy components and x_{iD}/x_{iM} for the light components.

5) From the assumed concentrations in the top and bottom products and the ratios from step 4, calculate the concentration of each of the components other than the key components at the feed entry.

6) Adjust these concentrations with the concentrations of the key components in the feed so that the total is 1.00.

7) This is a first approximation of the composition of the liquid phase at the feed entry. A second approximation may be made if desired. The second approximation should be made with relative volatility ratios calculated at the bubble point of the liquid as estimated in step 6. The concentrations of the key components as estimated in step 6 should also be used rather than the concentrations in the feed.

A sample solution is shown in Table 2.

Evaluation of Correlation

The evaluation of the application of this correlation to multicomponent mixtures has been made by comparison of solutions by the correlation and the more rigorous step-by-step method. A comparison of solutions could be made either by using the same heat balance and comparing the number of equilibrium steps required or by using the same number of equilibrium steps and comparing the heat balances. The former comparison has been made in these solutions. That is both solutions were made on the same basis as to heat load and the comparison is made between the number of equilibrium steps required.

In the examination of a comparison of this nature it should be borne in mind that the step-by-step method of calculation is not entirely rigorous. First, the method assumes the concept of equilibrium steps which, while rigorous for binary systems may not, in fact probably does not hold for multicomponent mixtures in actual fractionations. Second, most such calculations, and these are no exceptions, are based on idealized *K* charts. That is, they are based on the assumption of ideal solutions. In other words the only justification for using the stepwise calculations as a standard is the universal acceptance of this method based on years of experience.

Perhaps it should be further specified that these solutions were not intended to be practical designs but are merely sample solutions of specific separation problems.

In Table 3 is given the problem of debutanizing a hydrocarbon fraction and a comparison of the solutions from the two methods. The discrepancy in total number of equilibrium steps is not serious. It will be noticed, however, that the feed entry by the stepwise method is nearer the top of the fractionator than by the correlation. This observation will be discussed more fully later.

TABLE 3
Debutanizer at 120 Psia

Component	SEPARATION, MOLES		
	Feed	Distillate	Bottoms
C_2H_6	0.11	0.11	....
C_3H_8	11.15	11.15	....
iC_4H_{10}	8.29	8.29	....
nC_4H_{10}	25.37	25.00	0.37
iC_5H_{12}	5.21	0.11	5.10
nC_5H_{12}	11.51	....	11.51
C_6H_{14}	13.31	....	13.31
C_7H_{16}	8.31	....	8.31
C_8H_{18}	5.30	....	5.30
	88.56	44.66	43.90

Equilibrium Steps	METHOD OF CALCULATION	
	Stepwise	Correlation
Absorber	5.7	7.1
Stripper	10.0	7.2
Total	15.7	14.3

TABLE 4
Depropanizer at 270 Psia

Component	Feed	Distillate	Bottoms
C_2H_6	0.11	0.11	....
C_3H_8	11.15	11.00	0.15
iC_4H_{10}	8.29	0.05	8.24
nC_4H_{10}	25.00	....	25.00
iC_5H_{12}	0.11	....	0.11
	44.66	11.16	33.50

Equilibrium Steps	METHOD OF CALCULATION	
	Stepwise	Correlation
Absorber	10.7	12.5
Stripper	15.0	10.6
Total	25.7	23.1

TABLE 5
Isobutane-Butane Split at 100 Psia

Component	SEPARATION, MOLES		
	Feed	Distillate	Bottoms
C_3H_8	0.15	0.15	....
iC_4H_{10}	8.24	8.10	0.14
nC_4H_{10}	25.00	0.25	24.75
iC_5H_{12}	0.11	....	0.11
	33.50	8.50	25.00

Equilibrium Steps	METHOD OF CALCULATION	
	Stepwise	Correlation
Absorber	16.3	18.0
Stripper	18.0	18.5
Total	34.3	35.3

The depropanizing of the overhead product from the first problem is shown in Table 4 with a comparison of the two methods of solution. Again the discrepancy in the total number of steps is acceptable. And again the feed entry is higher on the fractionator by the stepwise method.

The third problem is the isobutane-n-butane split of the bottom product from the second problem. This problem and solution is shown in Table 5. It is evident from the feed composition in this case that the correlation should give very good results. For practical considerations the system is a binary system and the correlation is a true representation of such systems. The agreement here between the two methods is very good although once again the correlation shows more equilibrium steps required in the absorber than does the stepwise method.

The stepwise solution of all three of these problems locates the feed entry nearer the top of the fractionator than does the correlation solution. While this difference is not large enough to be serious and would be rectified in equipment design by proper consideration of tray efficiencies and the customary provision of multiple feed inlets, it is of interest to note that it is possible to obtain better agreement. The number of equilibrium steps required for a given separation is inversely proportional to the relative volatility ratio. In these solutions the relative volatility ratios were determined at the bubble point of the feed. These values are in these cases higher than the average value for the stripper and lower than the average value for the absorber. Therefore, better agreement between the two solutions could be obtained by use of average relative volatility ratios in each section of the column.

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Small Refinery Meets Gasoline Quality With Reformer and Poly Units

Flexibility of Peppers' modernization plan will permit company to change runs in line with fluctuations in market demand

E. M. BEEBE

Peppers Refining Company, Oklahoma City

THE Peppers Refining Company, located in the highly competitive gasoline marketing area of Oklahoma City, was confronted with the problem of augmenting its plant with facilities sufficiently modern to meet the gasoline quality demanded. Refining facilities consisted of combination crude topping-thermal cracking and sweetening units. The important factor considered was that any new equipment to be installed, in addition to upgrading gasoline stocks, should be sufficiently flexible to meet seasonal fluctuations in product sales. This, of course, required a unit which could process charge stocks which varied considerably in their characteristics.

Accordingly, the modernization plan was resolved by the installation of a catalytic reforming unit (Perco Cycloversion) and a catalytic polymerization unit. Perco Cycloversion was selected due to its flexibility and low operating and construction costs. With the Cycloversion unit, charge stocks can be varied from gasoline-boiling-range material, processed at desulfurization or reforming conditions, to gasoil which can be catalytically cracked. Each of these operations can be performed in this equipment because the same catalyst is used, the limitation being only the regeneration facilities provided. The Cycloversion unit when operated under reforming conditions permits the inclusion of a large front end portion of the kerosine fraction which alleviates a problem during the summer months when the market situation for this product is not favorable. Catalytic polymerization complemented the modernization program as the gases made from the Cycloversion unit operation are rich in olefins. These gases, as well as those from the thermal cracker, are polymerized to yield a valuable, high octane blending component instead of being burned as fuel gas.

Designed by Koch Engineering Company, all construction work on the 1000-barrel-per-day Cycloversion unit and the 100-barrel-per-day catalytic polymerization unit was done by Peppers personnel without interrupting other plant operations. It was possible to effect considerable economy by the utilization of a sizeable amount of existing equipment in the plant modernization program.

Description of Unit

The Cycloversion unit consists of two reactors which permit continuous operation, i.e., one reactor is on process while the other is being regenerated. Also included are fractionation and stabilization facilities. The unit was placed in operation in June, 1951, and has processed straight-run gasoline and cracked naphtha in blocked operation as well as various mixtures of the cracked and straight-run naphthas in combined operation. At present cracked and straight-run naphthas are being processed in blocked operation. This latter type of operation was resorted to because a better yield-octane relationship is realized when desulfurizing the cracked naphtha and reform-

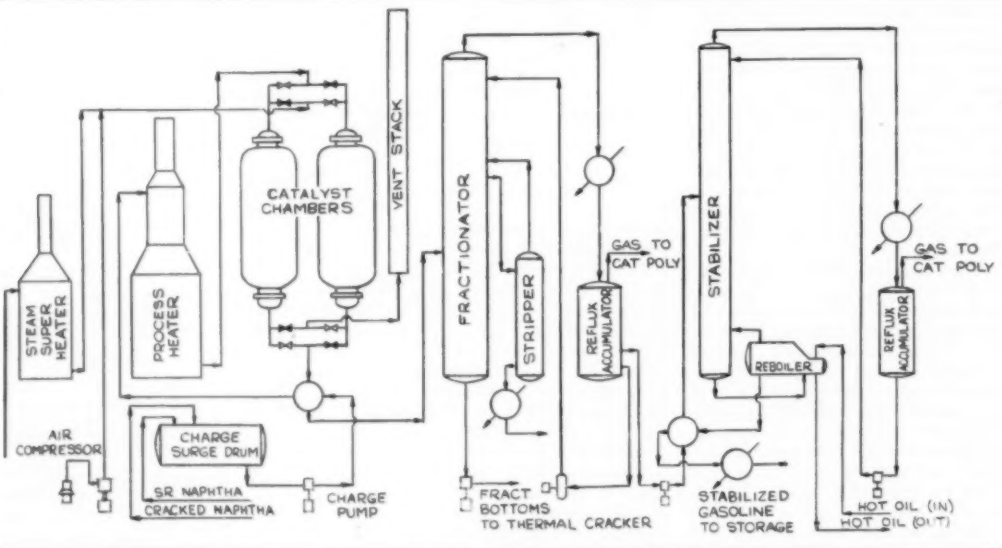

Figure 1. Flow Diagram of Cycloversion Unit, Peppers Refining Company, Oklahoma City.

ing the straight-run naphtha separately and blending the two products to make base stock for both the premium and regular grade gasolines.

When processing straight-run gasoline, operating conditions are generally somewhat more severe than when processing a cracked gasoline. The reason for this being that a straight-run gasoline charge is usually processed at the reforming level under which conditions two reactions, desulfurization and reforming, are accomplished. A cracked naphtha is generally processed at less severe conditions which effect desulfurization of the stock. Higher temperature levels tend to promote excessive carbon deposition on the catalyst when cracked naphthas are treated. A combined feed of straight-run and cracked naphthas is generally processed at operating conditions intermediate to the reforming or desulfurization operations.

Advantages of Unit

Figure 1 is a simplified flow diagram of the unit and Figure 2 is a general view of the complete unit. At the extreme left **(Figure 2)** can be seen the elevated horizontal feed surge tank. This surge drum is provided so that straight-run gasoline and cracked naphtha can be run simultaneously into it from the crude topping and thermal cracking units. The Perco unit charge pump takes suction on this tank. Such a processing scheme permits charging an essentially oxygen-free stock thereby minimizing low temperature carbonization of heat exchange equipment. To the right and in back of the surge drum is the fractionator overhead accumulator, which in addition to furnishing reflux to the fractionating column also serves as charge tank for the stabilizer. Just to the right of this accumulator can be seen the feed preparation facilities for the cat poly unit which handles olefinic gases from the Perco unit and the thermal cracker. In the center foreground is the steam superheater which furnishes the diluent for the air used in regeneration of the catalyst. Regeneration temperatures are controlled at the desired level by varying the air-steam ratio. To the right of the superheater is the process heater. Between these heaters the two reactor chambers can be seen and the stabilizer is shown behind them. It will be noted that the reactors are mounted high off the ground with the charge-catalyst cham-

TABLE 1
Perco Catalytic Reforming of Straight-Run Gasoline

RUN	1			2				3		
OPERATING CONDITIONS:										
Charge, B/D	657			1084				815		
Cat. Inlet Temp., °F	950			960				975		
Cat. Chamb. Press., Psig	50			63				60		
Gas Make, Cu. Ft./Bbl.	115			118				121		
RECOVERY:										
Gasoline, Volume Percent of Charge	95.5			70.4				94.2		
Naphtha, Volume Percent of Charge	0			22.6				1.8		
Frac. Btsm., Volume Percent of Charge	0			1.7				0		
Gas and Losses, Weight Percent of charge	4.5			5.3				4.0		
	Charge	**Prod. Gasoline**	**Naphtha**	**Charge**	**Prod. Gasoline**	**Naphtha**	**Frac. Btms.**	**Charge**	**Prod. Gasoline**	**Naphtha**
PRODUCT INSPECTION:										
Gravity API at 60° F	62.9	61.7		60.4	64.4	51.5	34.4	64.9	65.0	51.8
RVP at 100° F	8.4	6.5		5.5	10.7	0		9.3	7.8	0
ASTM Distillation, °F.										
Initial B. P.	115	114		116	95	184	194	94	95	154
10 Percent Evaporated	168	160		172	164	272	345	150	143	246
30 Percent	208	208		224	216	310	380	196	190	290
50 Percent	238	236		253	248	335	410	224	223	318
70 Percent	267	266		284	283	354	444	258	252	341
90 Percent	312	322		350	305	380	508	306	295	371
End Point	376	378		410	364	428	748	368	340	442
Rec. Volume Percent	99	95		99	95	99	97	99	97	99
Research Oct. No.'s.:										
Clear	49.8	60.1		46.8	59.5	39.0		53.8	61.0	45.0
+1 ml. TEL per Gallon	62.6	70.4		58.5	69.0			65.9	71.8	54.2
+3 ml. TEL per Gallon	74.5	80.2		71.7	79.4			75.8	81.9	68.2

TABLE 2
Perco Catalytic Desulfurization of Cracked Gasoline

RUN	1			2			3		
OPERATING CONDITIONS:									
Charge, B/D	784			818			840		
Cat. Inlet Temperature, °F	810			855			870		
Cat. Chamb. Press., Psig	75			55			58		
Gas Make, Cu. Ft./Barrel	41			50			66		
RECOVERY:									
Gasoline, Volume Percent of Charge	98.3			75.1			80.7		
Naphtha, Volume Percent of Charge	0			23.0			17.4		
Fract. Btms., Volume Percent of Charge	0.6			0			0		
Gas and Loss, Weight Percent of Charge	1.1			1.9			1.9		
	Charge	**Prod. Gasoline**	**Fract. Btms.**	**Charge**	**Prod. Gasoline**	**Naphtha**	**Charge**	**Prod. Gasoline**	**Naphtha**
PRODUCT INSPECTION:									
Gravity API at 60° F	58.4	58.6	31.4	60.2	62.8	44.5	60.5	64.1	43.0
RVP at 100° F	5.7	7.4		8.6	8.5			10.3	
ASTM Distillation, °F.									
Initial Boiling Point	116	98	190	100	87	190	94	95	167
10 Percent Evaporated	156	148	311	142	116	288	136	128	278
30 Percent	221	207	366	208	174	338	200	174	330
50 Percent	265	252	417	260	218	358	253	224	353
70 Percent	302	298	475	308	271	360	297	266	374
90 Percent	346	341	600	360	324	380	345	316	408
End Point	370	398		396	365	416	380	350	514
Recovery Volume Percent:									
Cracks at			696	97	98	99	99	99	99
Research Octane No.'s.:									
Clear	71.0	72.6		71.0	74.6	62.0	73.2	77.0	69.5
+1 ml. TEL/Gallon	79.1	81.5		79.4	83.6	70.7	81.0	85.6	75.2
+3 ml. TEL/Gallon	85.6	87.4		85.2	88.3	77.8	85.5	90.4	82.0

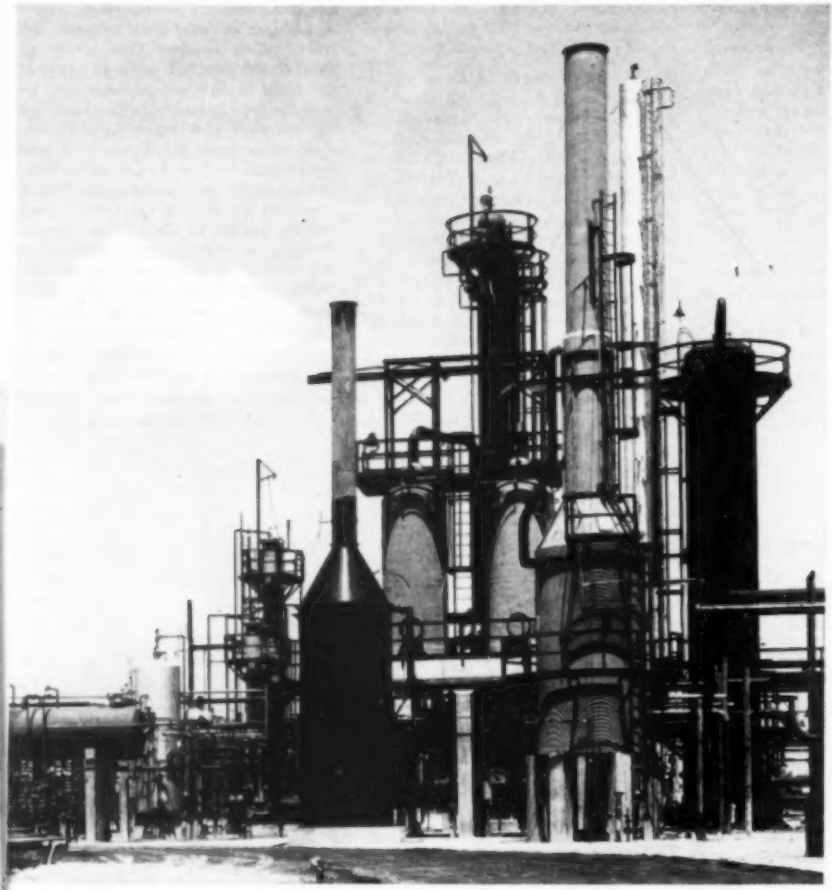

Figure 2. General View of Perco Cyloversion Unit.

ber effluent exchangers placed under them. This arrangement effects a considerable economy of ground area. The Perco fractionator, not shown in the photograph, has a side stripper which takes a cut from the tray located about half-way between the feed tray and the top of the column. This cut is shown as naphtha in the processing results given in Table 1.

Table 1 shows operating data and inspection tests on charge and product when processing straight-run gasoline. Data are given for reforming this gasoline when operating at three different catalyst chamber inlet temperatures.

Runs 1, 2 and 3 represent mild reforming of the straight-run gasoline. Gas make offers a very convenient means of predicting product octane numbers once a few runs have been made. Of course, the gas make product-octane number correlation can be made only on a given charge, i.e., when the charge stock characteristics change it is necessary to establish a new correlation. Gases produced by catalytic reforming are rich in olefins and are charged to the feed preparation section of the catalytic polymerization unit. In Run 1 no side cut was taken nor were any fractionator bottoms made. Runs 2 and 3 show that a side cut naphtha was taken. This naphtha is used as a blending component in making regular gasoline. The fractionator overhead gasoline is blended with the overhead product from the cracked naphtha operation to make the basic premium gasoline stock. Fractionator bottoms shown in Run 2 are charged to the thermal cracking unit.

Table 2 gives operating data and inspection tests on charge and product when processing cracked gasoline. Data are given for three different temperature levels for operating on this type charge. Again it is to be noted that results are shown with and without a naphtha side cut being taken from the Perco fractionator.

The side cut naphtha is used in the regular gasoline blend. In no case is the yield of product less than 97 percent based on the charge and, as in the previous operation given in Table 1, the olefins in the off gases are recovered as poly gasoline. Fractionator bottoms, representing not more than twenty barrels a day are disposed of as thermal cracker feed. Though no data have been presented for processing a wider boiling range cut, i.e., one which would contain the lighter portion of the kerosine fraction, such an operation is economicaly feasible and will no doubt be utilized during the slow market period for this product.

* * *

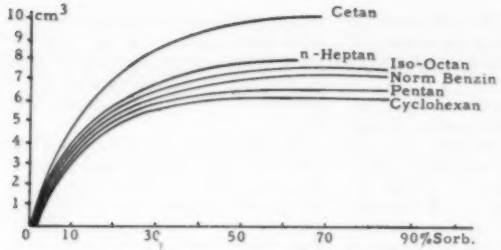

Figure 1. Adsorption with Silica Gel

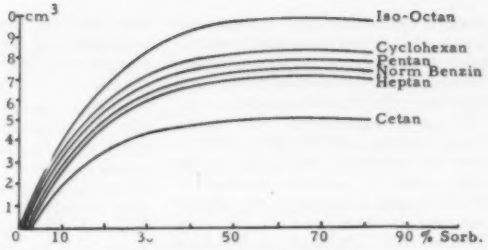

Figure 2. Adsorption with Charcoal

Selective Adsorption of Hydrocarbons

Part I

G. SPENGLER and K. KRENKLER

Translated by Edwin J. Barth, Petroleum Technologist

IN THE COURSE of our work studying analytical and separational procedures in hydrocarbon research work we selected methods based on adsorption as one phase in our investigations.[1]

This contribution describes the experimental work carried out, giving appropriate references up to 1945.

A rapid and noteworthy advance has been shown by the many publications in recent years on the subject of adsorption. It had been noted that pure substances could be obtained by various adsorption techniques from mixtures and raw materials of countless variety.[2] Adsorption methods used in other fields were soon found applicable in specialized hydrocarbon research work; a large array of items and references has formed a comprehensive literature on this subject, even though not too complete in the specific field of hydrocarbons and petroleum compounds.[3]

In general, the impression has prevailed that the subject of selective adsorption has been little investigated, despite increased applications in fields other than petroleum. H. Brockman[4] points this out in his work on fundamentals and on proposed procedures for measuring adsorption isotherms of various substances; this work was carried out to compare various existing and proposed procedures.

It was decided to work in the liquid or solvent phase after rejecting various preliminary experiments and their results in our search for a feasible procedure to later commercially separate hydrocarbon mixtures. In this investigation we sought some basis for relationships between adsorption agents, adsorption energy, selectivity, and the effects of temperature, solvents and techniques.

Laboratory Procedures

A) *Adsorption Techniques.* A method which proved especially adaptable was the contact procedure wherein the hydrocarbon mixture is contacted with the powdered adsorbent for several seconds until equilibrium is attained.

GREAT INTEREST has been recently focused on the separation and purification of aromatic hydrocarbons by adsorption techniques. Parallel with these developments in this country, there has been considerable activity in this field in Germany. The present article reports laboratory data from Germany on the adsorption of a large group of hydrocarbons on numerous absorbents.

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Agitation was carried out in glass-stoppered Erlenmeyer flasks.

B) Quantity Adsorbed. The concentration of the solute or adsorbate was determined before and after adsorption using a refractometer to determine the amount of substance adsorbed by the solid. Graphically the value zero indicates pure solvent, and 100 the pure adsorbate. In order to correlate percent concentration with quantity adsorbed in cubic centimeters, the first value must be multiplied by a factor obtained by dividing the quantity of remaining solvent by 100; this is for the purpose of plotting and obtaining adsorption isotherms.

C) Solvents. Among the many solvents available it apeared feasible to investigate the saturated hydrocarbons, such as benzine. The benzine employed in this work boiled between 40°-43° C., and was first treated with 60 percent fuming sulfuric acid until no further change was observed in the refractive index.

D) Types of Adsorbents. Most of the common adsorbents were first tested out in preliminary runs, and those showing weak adsorption tendencies were rejected. It was shown that finely divided high porosity silica gel adsorbed 8 cc benzene from a 100 cc of solution containing this aromatic when using 50 grams of gel as the adsorbent. This adsorbent proved to be the most efficient of all the adsorbents studied. Activated charcoal followed next in efficiency, adsorbing 7.2 cc of benzene; the latter was followed by an aluminum oxide adsorbing 1.2 cc of benzene. A bleaching clay adsorbed only 0.7 cc from the hydrocarbon solution.

The other adsorbents studied were Kieselguhr, magnesium oxide, zinc oxide, calcium carbonate, Kryolith, Portland cement; the refractive index of the benzene solutions remained unchanged after contacting with the adsorbents, indicating no adsorption tendencies.

In order to be able to make comparisons of the efficient adsorbents and

possible conclusions as to certain techniques, etc., it was necessary to obtain adsorption isotherms of several hydrocarbons, typical of certain groups, and also some of their homologues.

A set of experiments was started using benzene, toluene and xylene in order to determine the effect of the CH_3 group at constant number of double bonds. Using silica the adsorption was identical; that is, the same quantity was adsorbed in all three cases, as shown in Figure 1.

Using activated charcoal one notes a marked increase of toluene and xylene over benzene—about 25 percent for the toluene and approximately 50 percent for the xylene.

It appears that silica gel does not detect the presence of methyl groups on the benzene ring; activated carbon in this instance, however, affects decided differences. See Figure 2.

Experiments using aluminum oxide and bleaching clay showed no selectivity similar to silica gel.

It was of interest next to investigate the effect of double bonds in ring compounds; measurements were made using benzene, decalin, tetralin, and naphthalene. The results with silica gel are shown in Figure 1. It is seen that decalin is not selectively adsorbed, the tetralin curve being practically coincident with benzene. Naphthalene not being very soluble in benzene, its isotherm was only plotted in the early stages. Sufficient data was obtained, however, to indicate that this aromatic gave higher values than benzene and tetralin.

The isotherms derived from the activated carbon, in contrast, differentiate more clearly between these hydrocarbons. Decalin is adsorbed, even though to a low degree; with tetralin and naphthalene, showing a decided increase in values.

In order to coordinate the results, excluding from them the values for the low solubility naphthalene, it was desirous next to study the effect of side chains still further; we therefore prepared the isotherms for methylcyclohexane, toluene, and alpha-methylnaphthalene. Using silica gel (Figure 1) methylnaphthalene shows a relatively slight increase over toluene, yet to the extent of about 15 percent, while by the use of charcoal the increase is close to 50 percent; apparently the adsorption affinity due to the increased number of double bonds is additive to that obtained by molecular size.

Methylcyclohexane is not selectively adsorbed by either silica gel or the active charcoal. This is clear from the fact that here the necessary double bond is lacking for any adsorption effect. Another reason for non-adsorption may be that the difference in molecular size between the solute and solvent is too small to show adsorption effects.

In this connection an analogous result was obtained in a series of tests with cyclohexane, cyclohexene, and benzene. As was to be expected, cyclohexane is not adsorbed from the solvent by either silica gel or activated charcoal. The ratio of the adsorbed quantity of cyclohexene to benzene is not according to the relationship of 1:3 double bonds but 2:3 using the gel, and about 1:2 with the carbon.

The results of these adsorption tests also substantiate previous work indicating that three double bonds in benzene are equivalent to $1\frac{1}{2}$ olefin double bonds.

In the paraffin series isotherms for dodecane, cetane and octadecane were next obtained. With the paraffins the assumption has been, and observations were at hand to prove them, that the higher paraffins are not selectively adsorbed by silica gel. In our case the rare instance has occurred where the refraction has actually risen and with it the concentration of the high molecular weight hydrocarbon having increased; in other words, that the lower paraffins are adsorbed preferentially to the higher paraffins in the solvent (Figure 1). The higher boiling-point hydrocarbon is acting here apparently as a solvent; this is evident from the complete reversal of the isotherm on the one hand, and on the other hand, that the curvature originates not at zero value, but at some maximum value, and at 100 percent approaches the zero line. (The interesting parallel to this is the results of tests made on solvents discussed below).

Figure 2 shows the adsorption on activated charcoal to be quite high in contrast to the values for silica-gel; this again further substantiates observations that active carbon shows specific action on molecular weight. The difference of two carbon atoms between cetane and octadecane is too small to become apparent in these tests. Both are strongly adsorbed to about the same degree, and the curve almost coincides with that of benzene. In contrast to this, a decided decrease is seen in the case of dodecane.

A part of our program also comprised comparisons of various isotherms of the higher paraffins with the corresponding olefins; cetane and cetene were used in these determinations. As shown in Figure 2 above, active carbon is a strong adsorbent for long chain molecules; it adsorbs more than twice the quantity of cetene than does silica gel. Comparing the cetene and cetane curves one notes the unexpected result that activated carbon adsorbs both substances to an equal degree; in the case of silica gel (Figure 1) cetene is less adsorbed than cyclohexene; the cetane is "negatively" adsorbed.

One is forced to conclude that the reactivity of the double bond seems to disappear with increasing chain length using active carbon; that with silica gel, however, the unsaturation still asserts itself—though this adsorption tendency is hindered or considerably weakened by the negative or counteracting tendency of long hydrocarbon chains.

Using cyclohexene in the comparison (low molecular weight olefin) it can be concluded that with silica gel the adsorption decreases with increasing molecular weight for the same number of double bonds; using active charcoal, both effects appear additive, resulting in much higher value.

In comparing the isotherms discussed so far we also note that compounds without double bonds are hardly ever selectively adsorbed on silica-gel, and that in the case of the paraffins with increasing chain length, an opposite effect takes place, namely, an enrichment of the solvent.

Among the compounds with double bonds, cetene shows the least adsorption affinity; this can be probably traced to the fact that the aparently constant value (for the various groups) of the adsorption-affinity of the double bonds is depressed due to the counter-acting influence of the long chain.

Next follows cyclohexene adsorbed more strongly due to its smaller molecule, and finally, benzene and its homologues—the cyclohexene to benzene ratio being 2 to 3. The toluene and xylene isotherms fall in line with those for benzene; in the case of tetralin the difference is negligible. It is always evident that with silica-gel the effects of the double bonds is neutral or constant, and that any side chains or saturated rings attached thereto are much more discernible in regard to their counteracting influences. Naphthalene and methylnaphthalene are adsorbed to a greater degree, due to a larger number of double bonds though on a limited scale. The connection here may be that the increasing effect of concentration of double bonds is in part preserved due to the counteracting influence of the larger molecule.

In comparison, the active carbon isotherm shows a more pronounced differentiation. For instance, while in the case of benzene, active carbon shows still about the same activity as silica-gel, this activity increases to nearly double the value in the case

Figure 3 (Below). Adsorption of Benzene from Various Solvents with Silica Gel.

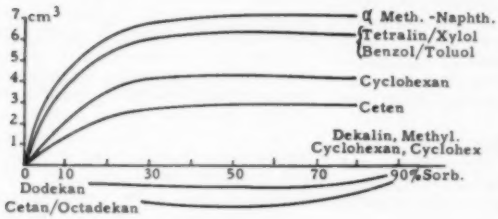
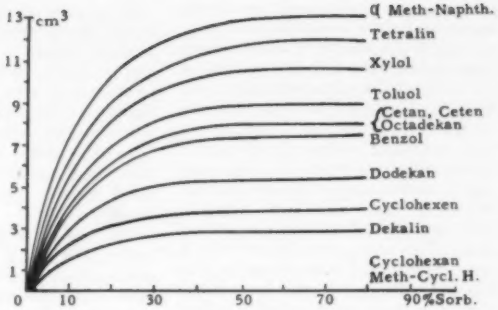


Figure 4 (Right). Adsorption of Benzene from Various Solvents on Activated Charcoal.



of methylnaphthalene with the gel. We know that cyclohexane and methylcyclohexane are not measurably adsorbed; as already mentioned, this could be related back to the fact that the molecular weights lie in the range of that of the petroleum solvent employed; a so-called adsorption pressure or driving force is lacking.

This becomes apparent in the case of decalin. Comparing this saturated ring compound with the paraffin, n-dodecane, it is apparent that it coincides with a two-fold adsorption increase based on the content of two carbon atoms; molecular structure plays an important role. It is further seen that with an increase in the number of carbon atoms the effect of olefin double bonds is of less importance than molecular weight; for example, cetane and cetene are equally strongly adsorbed.

In the case of toluene and xylene, increase in adsorption is again evident with increase in molecular weight; tetralin can be included, tetralin possessing four reactive carbon atoms. Increasing double bonds result in further adsorption increases, as expected in the case of methylnaphthalene.

Using these results in evaluating separation procedures such as those given in the literature,[5] and substantiated in later investigations, it can be said that:

1) Silica gel shows a pronounced efficiency for separating saturated from unsaturated hydrocarbons; saturates are not "negatively" adsorbed with increase in their chain length.

2) For cases, however, where it is desirable to separate substances based on length of side-chains and saturated groups, or on molecular weight, we find that activated charcoal is the proper adsorbent. This adsorbent is well adapted for use in separating low from high molecular weight paraffins. It has not been found especially adaptable, as yet, to separate higher olefins from higher paraffins—since both are about equally strongly adsorbed.

3) Silica gel and active carbon appear to be most active adsorbents, each having certain characteristics for various hydrocarbons.

The measure of the substance adsorbed from liquid phase (or solvent) by a particular adsorbent can be ascertained from a differential rate or percentage value; this value is a resultant of the adsorption-affinity of the solute, adsorbate) and the unique adsorption effects shown by the solvent itself. It is designated as an adsorption gradient.

The differential gradient is the basis of selective adsorption, and the determination of the rise or increase of this value was an important part of our investigations. Adsorption-affinity can be expressed as a definite value; a high gradient or slope can only be attained by selecting a solvent possessing the lowest possible adsorption.

Traube's rule states that adsorption tendency increases with molecular weight. Our first hypothesis was as follows, namely, adsorption tendency of the hydrocarbon solvent itself decreases with decrease in number of its carbon atoms. Therefore, the adsorption gradient, (incline or slope) increases in relation to the adsorbed substance. We, therefore, employed as a solvent, a low-boiling "petroleum ether" fraction, B.P. 30°-60° C. for the first series of tests.

It was also desirable to determine the effect of the molecular weight of the solvent. Experiments were carried out using pentane, cyclohexane, "normal benzine," heptane, iso-octane and cetane; the boiling-points were therefore in the range of 30°-275° C. Benzene was again used as the adsorbate, with silica-gel and activated charcoal as the adsorbents. The results are shown in Figures 3 and 4.

Figure 3 shows that with silica-gel the adsorption did not, as expected, decrease, but actually increased with an increase in the number of carbon atoms in the solvent. In addition the values as seen in the diagram are quite definite; for instance, the adsorption from cetane is 1.5 times greater than from pentane. In the case of the n-paraffins, therefore, there appears to be a definite constant relationship between the number of carbon atoms and the quantity adsorbed; the experiments indicate also the position of pentane in relation to heptane and cetane, "normal benzine" laying just above the pentane curve. The odd position of cyclohexane below that of pentane could be explained, perhaps, by its greater "internal strain," due to ring structure, as revealed by its higher adsorption tendencies.

The results show that iso-octane lies slightly below the n-heptane curve, analogous to the above. A degree of similarity is seen here in comparing the boiling-points of 98° C. for heptane, and 99° C. for iso-octane—practically identical.

In a second series of measurements, using activated charcoal and benzene, practically the reverse results are obtained. Figure 4 shows the adsorption from n-paraffins to decrease with increase in carbon atoms of the solvent; there is a pronounced effect or difference, so that in the case of cetane only a little more than half is adsorbed than in the case of pentane. The "normal benzine" curve is again adjacent to the heptane curve. Cyclohexane again is in an odd position in this instance, above the pentane curve. The hypothesis of greater "internal strain" for cyclohexane cannot be applied here for in that case this solvent would have to show a greater adsorption-affinity than it does, which is not the case. An explanation could possibly be sought in the fact that activated carbon shows a unique tendency for adsorbing chain-type hydrocarbons. This view could be substantiated by earlier tests where it was shown about twice as much dodecane than decalin is adsorbed by active charcoal.

Iso-octane assumes a miscellaneous position since it shows the least tendency to be adsorbed by active carbon: this proves it to be the best type of solvent for adsorptions of this type.

Our work with active carbon supports the view that the affinity for adsorption of the solvent increases with increase in the number of carbon atoms of the solvent. We lack an explanation for the results obtained with silica gel. First, we sought an explanation based on the pore structure of the gel as being too small, or dense for the larger hydrocarbon molecules; the literature reports such instances. Comparative experiments made with large pore-size silica gel showed that such is not the case. More often, we found from a large number of experiments that Traube's rule is not valid for adsorption phenomena using paraffin hydrocarbons and silica gel, however well it might be applied in the case of active charcoal.

Repeated adsorption experiments with the gel showed that the adsorption does not increase but definitely decreases with increase in molecular weight.

Heat of wetting of a substance is closely related to its adsorption-affinity. The work of Stenzel corroborates our findings; this investigator found that the heat of wetting of n-decane, B.P. 175° C. with silica gel is identical with that of n-hexane, B.P. 69° C. In further substantiation it is, of course, known that the n-paraffins are apparently devoid of surface activity.

Explanations were sought for the unexpected behavior of silica-gel; we believe the following aids in interpreting some of our results: it is well known that silica gel is strongly hydrophillic, and is a polar type of adsorbent; adsorbed substances can be eluted with water and the alcohols. Water-solubility of the n-paraffin being practically nil, one cannot determine differences in behavior of individual homologues. The alcohol solubility mentioned in this connection shows a distinct decrease with increase in the number of carbon atoms of the paraffins. It can also be definitely stated that the affinity of the paraffins for OH groups decreases with increase in molecular size. With respect to the polar behavior of silica gel, the decreasing affinity of the n-paraffins can be hardly explained in this manner; on the other hand, the indirect proof of the actual adsorption of the paraffins would be clarified if one assumes active centers of strong affinity for particular groups.

In contra-distinction to the above hydrophillic silica-gel, we find activated charcoal quite hydrophobic; it would conform with Traube's rule. In other words, the quantity adsorbed increases with increase in molecular weight—on a weight basis. Our findings support this.

Effect of Temperature

Since adsorption phenomena are affected by temperature, it was of interest to determine some of the variables in this connection. A series of determinations were carried out, using similar techniques as in previous experiments. Benzene solutions in petroleum ether were used in conjunction with small pore-sized silica gel, activated carbon, aluminum oxide, and bleaching clay.

The ranges of temperature studied were 20° C. and minus 78° C. (alcohol-carbon dioxide bath). Since benzene crystallizes out of solution at low temperatures when used in low concentrations, we were forced to use rather narrow ranges of concentration in order to obtain reliable results.

In these experiments we noted at once that adsorption increases linearly as temperature decreases. The effect is completely reversible; in other words, if the system is again warmed to the initial temperature, the original equilibrium, and same index of refraction is again obtained. However, adsorbents do not all behave alike in regard to increased adsorption in the cold.

Dividing the low temperature adsorption value by that found at ordinary temperatures, a constant is obtained characteristic for each adsorbent; it is reproducible over a variety of concentration ranges. The factor decreases somewhat with lower concentrations; this is related to the fact that the final concentration had reached a minimum. A factor of 1.55 was obtained for silica gel, 1.8 for activated charcoal, and 3.0 for aluminum oxide and bleaching clay. In the range of from 20° C. to minus 78° C., adsorption increases to that extent, and again decreases upon warming the system.

These factors are in reverse relationship to the adsorption energy of the particular adsorbent. It can be concluded that at low temperatures various adsorbents approach some highest value or maximum.

A method therefore is available to determine the adsorption energy of a particular adsorbent including type and approximate distribution of active centers.

With this procedure the effects or influence of the adsorbent to that of adsorbate, solvent, and temperature are substantially clarified.

A later paper will report our findings concerning relationships existing in adsorption columns employed for separating a variety of mixtures.

Summary

Attempts have been made in the field of selective adsorption to obtain further information of fundamental nature useful for the separation of various hydrocarbons.

Index of refraction measurements before and after adsorption served as a useful method to determine changes in concentration of adsorbate in the solvents employed.

In the study of the several variables, the adsorbents used were silica gel and activated charcoal, which proved most suitable among the several studied.

The solvent used was a low-boiling light naphtha fraction freed of olefins and aromatics by pretreatment with oleum.

The investigation comprised the determination of adsorption isotherms for a series of hydrocarbons, to be used in later adsorption work in columns.

It was seen that the specific action of silica gel and active charcoal is due to minute differences in their physical structure—properties which are valuable for special applications.

Predictions of the results possible in adsorption separations could be substantiated for the hydrocarbon mixtures studied.

Adsorptions from several saturated hydrocarbon solvents indicates that Traube's rule is only partially valid.

A pronounced increase in adsorption-efficiency is obtained by the use of low temperatures.

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End of Part I. Part II will follow in an early issue.

Trend in Motor Fuel Volatility Is Still Upward

However, the postwar increase has been at a slower rate than prewar

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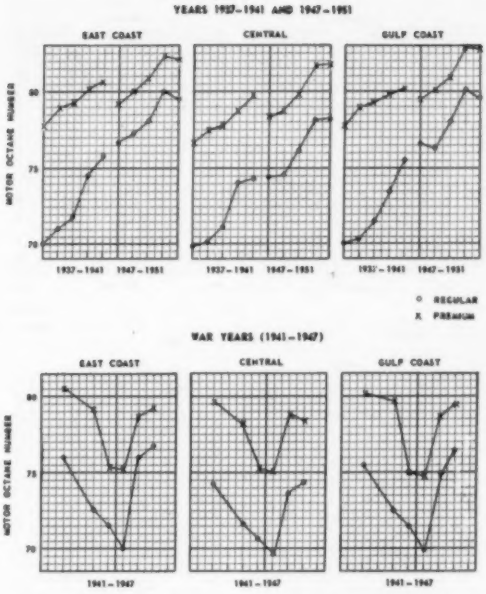


Figure 1. Trends in Motor Octane Numbers of Summer Gasolines.

THE most important properties of motor fuels are combustibility, volatility, and purity. Combustibility, in terms of heat units, and purity can be rather cavalierly dismissed in considering major trends in quality. Combustibility, in terms of octane number, and volatility do exhibit pronounced trends, however.

For many years octane number has been the chief commercial characteristic of motor fuel. Progress in the refining and automotive industries has resulted in a steady increase in the octane number of gasoline (see Figure 1) and the octane number requirements of automobile engines.

The steady increase in the octane number of motor fuels has been achieved by the refining industry by drastic revisions of processing. These process revisions have had to be kept in tune with the ever shifting quantity and quality of the basic raw materials as well as with changing demands for the other major liquid products of petroleum. In this complex situation the volatility of motor fuel (within vague limits) has been a major degree of freedom.

The purpose of the present review is to show the trends in motor fuel volatility by areas (East Coast, Gulf Coast, Central, Altitude, West Coast), by seasons (summer and winter), by grades (regular and premium), by eras (prewar, transitional and postwar), by ingredients, by processes and by performance features. Only a small fraction of the details can be included and hence most of the data are presented graphically as examples or summaries. When examples are given it should be remembered that similar but varying relationships prevail in corresponding permutations of the examples.

The authors are proposing a new way of analyzing motor fuel volatility trends, i.e., using as ordinates the sums of the 10 and 30 and of the 70 and 90 percent evaporated distillation temperatures. In addition to affording a convenient method of appraising changes in volatility in terms of light and heavy fractions this method has already proved extremely useful for defining the average volatility, the effects of various ingredients, changes in crude oil type, refinery processes and yields, and the results of volatility changes in terms of those engine performance features dependent on volatility.

Bureau's Motor Gasoline Surveys

This review is based on the National Motor Gasoline Surveys of the United States Bureau of Mines, summer 1937 through summer 1951. The method of averaging used in these surveys is to consolidate the gasoline samples within districts into "items" according to brand names. District averages are arithmetic averages of the "items" and national averages are arithmetic averages of the districts. The arithmetic method of averaging subjects the survey data to the criticism that small volume "items" and "districts" are given as much weight as large ones. In addition, there is the criticism that the coverage of the survey is incomplete. Nevertheless, although the average values of the USBM surveys may not be for the average gasolines, it is believed that the trends in the average values are of real significance. Thus, although the 50 percent distillation temperatures of 1937 and 1951 regular gasolines may not have been 249° and 232° F., it is quite likely the 50 percent temperature of the average gasoline has decreased 17° F. between 1937 and 1951.

In the use of the USBM survey data the "districts" are too numerous for the purposes of this discussion. Consequently the districts have been combined into five areas as shown in Table 1.

In striking averages for these areas the "district" data have been weighted for the number of "items" in each "district."* Thus, the error introduced by arithmetic weighting of "districts" equally is eliminated and the errors in considering national averages are completely eliminated by considering the areas separately.

In regard to the completeness of coverage of the USBM surveys this probably varies from district to district. In the Central Area very good

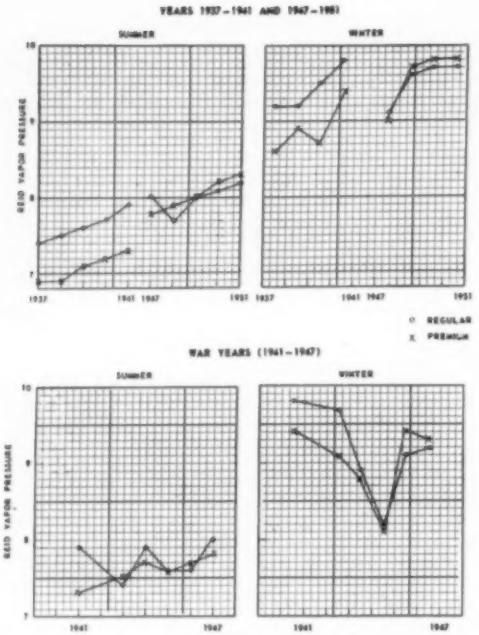


Figure 2. Trends in Reid Vapor Pressure of Gulf Coast Gasolines.

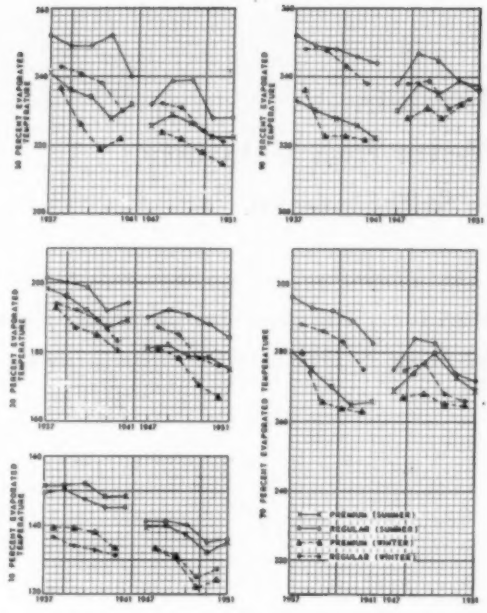


Figure 3. Trends in 10, 30, 50, 70 and 90 Percent Evaporated Temperatures of Gulf Coast Gasolines.

agreement has been found between private survey data and the USBM survey data. Table 1 compares the percentage of motor fuel sales by areas with the percentage of "items" included in the USBM surveys for the years 1937, 1941, 1947, and 1951. In the 1951 summer survey there were 556 "items" based on 3427 gasoline samples. The total number of gasoline samples for the surveys, summer 1937 through summer 1951, was 63,884.

The USBM surveys have the virtue of being a continuous record of motor fuel quality based on a reasonably consistent method of sampling.

TABLE 1
Comparison of Distribution of U. S. Bureau of Mines "Items" with Motor Fuel Consumption in Various Areas[1]

AREA	1937		1941		1947		1951	
	"Items"	Use	"Items"	Use	"Items"	Use	"Items"	Use[2]
East Coast:								
Conn., Del., Me., Md., Mass., N.H., N.J., N.Y., Pa., R.I., Vt., Va., W.Va.[3], D.C.	24.1	30.6	19.5	29.3	12.3	24.5	11.9	24.5
Central:								
Ark.[4], Ill., Ind., Ia., Kan.[4], Ky., Mich., Minn., Mo., Nebr., N.D., Ohio, Okla., S.D., Tex.(N)[5], W.Va.[5], Wisc.	43.1	38.7	41.6	38.2	46.9	37.3	46.0	37.2
Gulf Coast:								
Ala., Ark.[5], Fla., Ga., La., Miss., N.C., S.C., Tenn., Tex.(N)[5], Tex. (S)	11.9	15.9	17.7	17.6	16.4	29.3	16.6	21.0
Altitude:								
Ariz., Colo., Idaho, Mont., Nev.[5], N.M., Utah, Wyo.	7.3	3.7	11.0	3.6	13.2	4.4	13.2	4.3
West Coast:								
Calif., Nev.[5], Ore., Wash.	13.6	11.1	10.2	11.3	11.2	13.5	12.3	13.0
Total Items (Summer and Winter)	947		1093		1133		1129	

[1] Data from Petroleum Facts and Figures; Ninth Edition, 1950. [2] 1949. [3] Surveys prior to winter 1947-1948. [4] Surveys after summer 1947.

TABLE 2
Comparison of Volatility of 1937 Winter and 1951 Summer Gulf Coast Gasolines

	REGULAR		PREMIUM	
	Winter 1937-1938	Summer 1951	Winter 1937-1938	Summer 1951
Reid Vapor Pressure (lb.)	9.2	8.2	8.6	8.3
10 Percent Dist. Temp. (F.)	136	136	139	135
30 Percent Dist. Temp. (F.)	194	185	193	178
50 Percent Dist. Temp. (F.)	243	229	237	222
70 Percent Dist. Temp. (F.)	288	272	280	269
90 Percent Dist. Temp. (F.)	348	336	336	337

Reid Vapor Pressure

The Reid vapor pressure of motor fuels have shown some interesting tendencies toward changes as is exemplified in Figure 2, which shows vapor pressures from 1937 to 1951 for summer and winter regular and premium gasolines in the Gulf Coast Area. Perhaps the most striking feature of this chart is the pronounced difference in practice prewar and postwar in the vapor pressures of premium and regular gasolines. Prewar premium gasolines had markedly lower vapor pressures than regular gasolines. Postwar there is a decided tendency for the vapor pressure of premium gasolines to equal or even slightly exceed that of regular gasoline. Another notable feature of Figure 2 is the tendency for vapor pressures to increase. The effect of the war years is shown in the lower diagrams as a matter of interest.

In comparison with the vapor pressures of Gulf Coast gasoline Table A indicates the differences for the other areas.

The differences in vapor pressures between premium and regular gasolines noted for the Gulf Coast are common

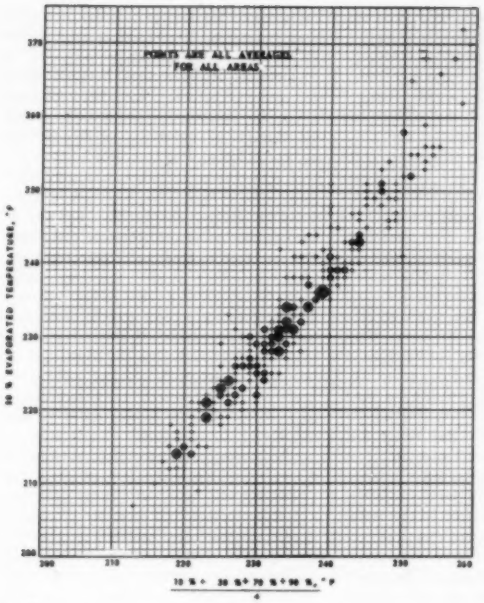


Figure 4 (left). Relationship of Sum of 10, 30, 70, and 90 Percent and 50 Percent Evaporated Temperatures.

Figure 5 (below). Variability of Gasoline Volatility Summer Gasolines.

to all areas.

Distillation Temperatures

The individual distillation temperatures are important in many aspects of motor fuel volatility. Figure 3 shows the trends in the 10, 30, 50, 70 and 90 percent distillation temperatures of summer and winter regular and premium gasolines in the Gulf Coast Area. Except for the 70 and 90 percent distillation temperatures of postwar premium gasolines, the trends for all five distillation temperatures are sharply downward. The full import of these volatility trends is forcibly exemplified by the fact that the summer gasolines of 1951 were more volatile than the winter gasolines of 1937-1938. This is demonstrated in Table 2.

In general, Figure 3 is a preview of the subsequent relationships in that it clearly demonstrates the continuing but slackening increase in average volatility and the reversal of these trends for premium gasolines in terms of tail end volatility.

The New Method of Analyzing Motor Fuel Volatility

As was stated earlier, interesting and useful relationships can be established on graphs using these ordinates

TABLE A

	Summer	Winter
East Coast	Higher	Considerably higher
Central	Higher	Considerably higher
Altitude	Lower	Higher (regular decreasing)
West Coast	Lower	Lower (regular decreasing)

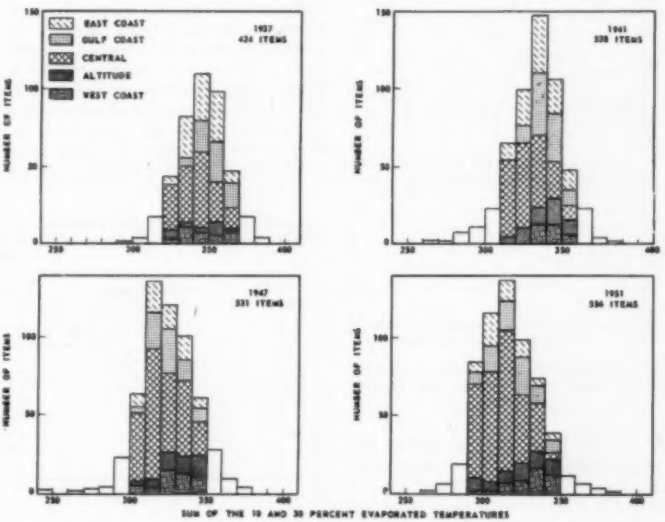
(10 + 30 vs. 70 + 90) for many aspects of motor fuel volatility. It is illustrative of the wide usefulness of this system that it originated in our company studies of the relationships between over-all volatility and vapor lock. It has been a simple matter to extend its use to other performance features and to the effects of refinery processes and operations on gasoline volatility.

An important distillation point (the mid point) is omitted from the 10 + 30 vs. 70 + 90 graphs. However, Figure 4 demonstrates a fairly consistent relationship between the sums of the 10, 30, 70 and 90 percent temperatures and the 50 percent temperatures. It is therefore concluded that either the sum of the four selected temperatures or the 50 percent temperature is a reasonable approximation of the average volatility of "normal" motor fuel. On diagrams with sums of 10 + 30 and 70 + 90 distillation temperatures as increasing ordinates, lines representing equal average volatility extend diagonally from left to right.

Considering the three variables, light fractions, heavy fractions, and average volatility, and ignoring when one is unchanged there are six sectors into which motor fuel volatility changes can fall. See Table B.

TABLE B

SECTOR	1	2	3	4	5	6
Light Fractions	More	More	More	Less	Less	Less
Heavy Fractions	Less	More	More	More	Less	Less
Average Volatility	More	More	Less	Less	Less	More



The Extremes In Gasoline Volatility

Because it is always an immediate problem, the variability in the volatility of motor fuels at any one time is more of a problem than are the long term trends. That this is so is exemplified by Figures 5, 6, and 7.

Figure 5 presents frequency diagrams for the sum of the 10 + 30 distillation temperatures of summer regular and premium gasolines for the

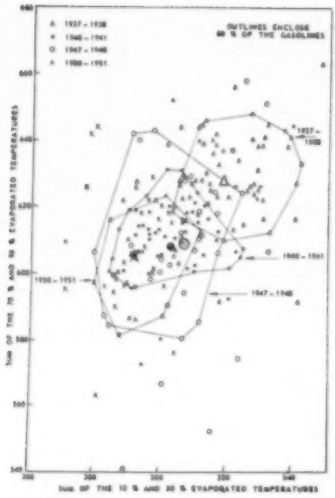

OUTLINES ENCLOSE 80 % OF THE GASOLINES
1937 - 1938
1940 - 1941
1947 - 1948
1950 - 1951
Sum of the 70 % and 90 % evaporated temperatures
Sum of the 10 % and 30 % evaporated temperatures

Figure 6. Variability and Trends of Volatility in East Coast Winter Regular Gasolines.

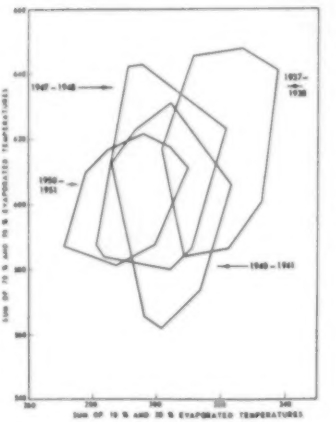

1947 - 1948
1937 - 1938
1950 - 1951
1940 - 1941
Sum of 70 % and 90 % evaporated temperatures
Sum of 10 % and 30 % evaporated temperatures

Figure 7. Variability and Trends of Volatility in East Coast Winter Regular and Premium Gasolines.

years 1937, 1941, 1947, and 1951. The longer frequency bars are subdivided by areas. The spread in the front end volatility (10 + 30) is very large and the distribution pattern although shifting to lower temperature levels is relatively unchanged. Similar diagrams for the sum of the 70 + 90 distillation temperatures would manifest a changing distribution pattern with a lessening in the spread and a very great lessening of the trend toward lower temperature levels.

In Figure 6 the volatility of the winter regular gasolines in the East Coast area are shown for the years 1937, 1941, 1947, and 1951. The points are "items" from the USBM surveys and the frameworks are rough approximations enclosing 80 percent (in each direction) of the items for each year. Figure 7 shows the effect on the frameworks of Figure 6 of including the winter premium gasolines.

These three diagrams illustrate only a part of the picture. First, as will be seen later, there is a considerable difference in volatility levels among the different areas. Second, the effect of transitional gasoline volatility in Spring and Fall greatly increases the variability during these seasons, i.e., half the year. Third, the average life of a passenger car embraces more than two of the years shown in Figures 6 and 7. It is obvious that the variability in volatility of motor fuels that a passenger car may encounter during its useful life far exceeds the variations brought out by trends. However, it is important to note that the least volatile gasolines are becoming more volatile.

This extreme variability in the volatility of gasolines is the resultant of many factors involved in a very complex petroleum industry. The most important factors are raw materials, product demands and processing facilities and these vary widely among the many units of the oil industry who contribute to the motor fuel supply. It is a major problem to automotive engineers to whom it is no consolation to observe that diagrams similar to Figures 5, 6, and 7 can be developed for every characteristic of motor fuel, including octane number. It should, however, be some consolation to note (from Figure 7) that the variability in gasoline volatility is considerably less in 1951 than in earlier years.

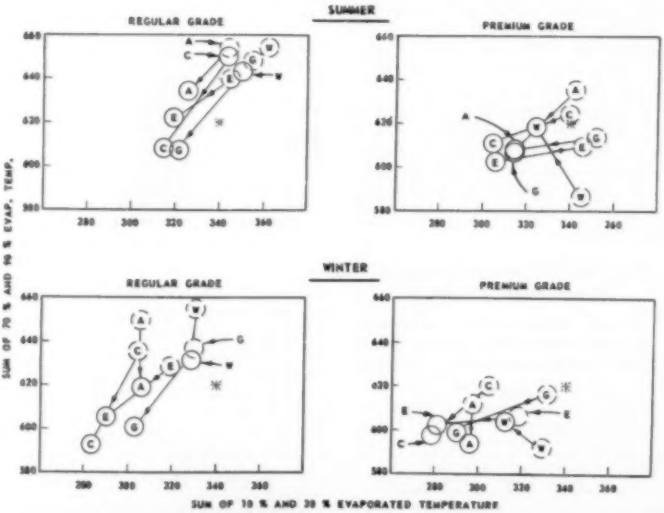
Trends in Average Volatility

Figure 8 (using the 10 + 30 vs. 70 + 90 ordinates) shows the overall changes in volatility of motor fuel by areas from 1937 to 1951 for summer and winter regular and premium gasolines. Over the 14-year period there has been a substantial increase in average volatility of regular gasolines and a lesser increase for premium gasolines, West Coast excepted. The disparities among the several areas and between the two grades are particularly noticeable. When the scattering of points shown in Figure 6 is imagined for each of the points in Figure 8 it is literally true that motor fuel volatility has been "all over the map."

The average increases in volatility between winter and summer gasolines (both regular and premium) and between premium and regular gasolines (both summer and winter) are shown in Figure 9. The legend in dashed lines indicates the prewar increases; in solid, the postwar increases.

Both the seasonal and grade changes in volatility are different postwar than prewar. The seasonal change in volatility is in the direction of relatively more undercutting and less light fractions. The grade change in volatility is in the opposite directions and there is a decided tendency of the postwar premium gasolines east of the Altitude Area to have almost the same volatility as the regular gasolines.

Figure 8. Trends in Motor Fuel Volatility (1937-1951) (Broken-line circle, 1937; solid-line circle, 1951. E, East Coast; G, Gulf Coast; W, West Coast; C, Central; A, Altitude. Asterisk, Reference Point).



The manner in which the changes in volatility of motor fuel has taken place in the three periods, prewar (1937-1941), transitional (1941-1947), and postwar (1947-1951) is shown in Table 3 for regular and premium gasoline. The prewar reliance of the refining industry on processes in which increases in octane number were accompanied by increasing proportions of light fractions and decreasing portions of heavy fractions is shown by the preponderance and magnitude of the decreases in both the sums. The extreme undercutting of prewar premium gasoline is quite noticeable. In the transitional period much the same trends are observed for regular gasolines in regard to undercutting but there was a slackening in increasing front end volatility. The chief change in volatility of premium gasolines in the transitional period was a drastic reversal from undercutting to end point elevation. Postwar the volatility changes have been somewhat less than in the other two periods. Front end volatility is still increasing, as also are undercutting for regular gasoline. The West Coast Area, particularly postwar and the Altitude Area stand out in Table 3 as exceptions. For example, postwar regular gasolines of the West Coast Area have manifested end point elevation and prewar regular gasolines of the Altitude Area exhibited small volatility changes.

In terms of the sectors previously described the volatility changes during the entire period have been consistently in Sector 1 with a few exceptions. Prewar the changes were large. During the transition period there was a tendency for the changes in volatility of regular grade gasoline to become smaller and to veer toward Sector 2. There is a pronounced movement of the volatility trends of transitional premium gasolines from Sector 1 to Sector 2. Postwar the volatility trends are of still lesser magnitude. Trends for regular gasolines continue to veer toward and into Sector 2, while trends for premium gasolines veer back toward Sector 1. The pronounced reversal of volatility trends (Sector 1 prewar and Sector 4 postwar) in the West Coast Area probably indicate increasing shortages of light ends and the rapid application of catalytic cracking operations. The anomalies manifested by the Altitude Area are probably illustrative of its shifting sources of supply resulting from its position between the two areas with the widest extremes in volatility.

Table 3, in conjunction with relationships established subsequently, is a sort of abbreviated history of the raw materials and gasoline processes of the refining industry.

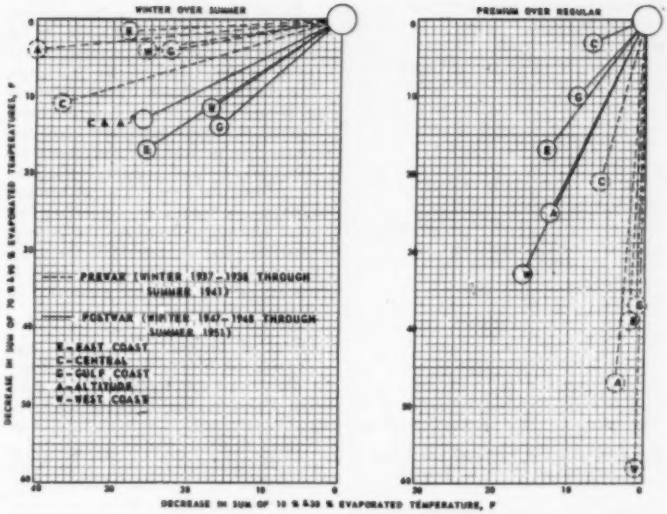

WINTER OVER SUMMER
PREMIUM OVER REGULAR
PREWAR (WINTER 1937-1936 THROUGH SUMMER 1941)
POSTWAR (WINTER 1947-1948 THROUGH SUMMER 1951)
E-EAST COAST
C-CENTRAL
G-GULF COAST
A-ALTITUDE
W-WEST COAST
DECREASE IN SUM OF 10 & 50 % EVAPORATED TEMPERATURES, F
DECREASE IN SUM OF 10 & 50 % EVAPORATED TEMPERATURE, F

Figure 9. Volatility Increases for Grades and Seasons.

Trends In Volatility And Octane Number

The very complex relationships between volatility and octane number are exemplified by the anomalies which prevail for practically every correlation attempted.

In general, there are widely differing levels for both volatility and octane numbers for the West Coast Area in comparison with the three eastern areas with the Altitude Area exhibiting characteristics of both. Among the three eastern areas, the volatility levels are highest and the octane numbers are lowest in the Central Area. These relationships are generally understood.

In Table 3, the changes in octane

TABLE 3
Increases (Decreases) in Octane Number and Sums of Distillation Temperatures (10 + 30 and 70 + 90) for Prewar, Transitional, and Postwar Periods

		REGULAR GRADE								
		Prewar (1937-1941)			Transitional (1941-1947)			Postwar (1947-1951)		
		Change in			Change in			Change in		
AREA	SEASON	MON	10+30	70+90	MON	10+30	70+90	MON	10+30	70+90
East Coast:	Winter	4.4	(16)	(20)	1.7	4	1	3.6	(15)	(4)
	Summer	5.9	(10)	(10)	0.9	(9)	(7)	2.7	(8)	(1)
Gulf Coast:	Winter	4.4	(16)	(23)	1.3	6	0	4.0	(17)	(13)
	Summer	5.5	(15)	(21)	1.0	(10)	(14)	3.1	(8)	(5)
West Coast:	Winter	2.8	(14)	(21)	2.5	8	(20)	0.9	4	17
	Summer	4.6	(14)	(13)	0.7	(2)	(10)	0.5	5	12
Central:	Winter	3.5	(9)	(23)	0.4	3	(12)	4.4	(14)	(8)
	Summer	4.4	(15)	(18)	0.1	(7)	(24)	3.7	(7)	0
Altitude:	Winter	2.3	4	(4)	0.3	(1)	(21)	3.2	(3)	(7)
	Summer	2.5	5	(4)	0.2	(7)	(16)	2.3	(15)	0
National Averages:	Winter	3.6	(11)	(20)	0.9	5	(8)	3.5	(9)	(4)
	Summer	4.7	(11)	(16)	0.4	(7)	(14)	2.5	(7)	0
		PREMIUM GRADE								
East:	Winter	2.0	(15)	(36)	(0.9)	(7)	27	3.1	(15)	3
	Summer	2.8	(12)	(17)	(1.3)	(18)	16	2.8	(9)	(5)
Gulf Coast:	Winter	2.2	(19)	(31)	0	1	19	3.3	(23)	4
	Summer	2.4	(13)	(25)	(0.6)	(14)	11	3.3	(12)	7
West Coast:	Winter	1.9	(9)	(23)	(0.8)	(13)	21	1.0	5	12
	Summer	2.0	(3)	(14)	(0.6)	(17)	19	(0.5)	(2)	27
Central:	Winter	2.3	(15)	(19)	(1.1)	1	(9)	3.8	(10)	8
	Summer	3.0	(20)	(24)	(1.3)	(3)	1	3.3	(8)	10
Altitude:	Winter	2.9	7	(29)	(1.2)	(9)	10	2.9	1	(2)
	Summer	3.5	(5)	(38)	(1.4)	(5)	8	2.3	(18)	5
National Averages:	Winter	2.0	(13)	(25)	(0.8)	(5)	5	3.1	(8)	8
	Summer	2.5	(15)	(25)	(1.0)	(9)	9	2.5	(4)	10

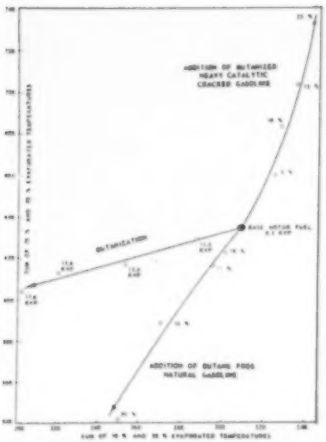


Figure 10. Effect of Particular Motor Fuel Ingredients on Motor Fuel Volatility.

number by seasons, grades, periods, and areas are shown in comparison with the corresponding volatility changes. In making these comparisons not much can be added that is not more or less self-evident from a consideration of Figure 1 and of the discussion of average volatility. However, it is notable that the end point elevation in transitional premium gasolines generally and in postwar West Coast premium gasolines was accompanied by decreases in octane number.

Volatility Effects of Ingredients

Figure 10 shows quantitatively the effects on the volatility of 1951 summer gasoline of adding several proportions of butanized heavy catalytic cracked gasoline fractions, natural gasoline and butanes. The effect of adding butanized alkylate was also determined but the effect was negligible for additions up to 25 percent.

These added ingredients, although important, were selected to be illustrative from a volatility viewpoint of extremes of light, intermediate and heavy fractions. The relationships established should be considered strictly from the viewpoint of volatility rather than in terms of the specific ingredients selected for the study. For example, the volatility effects of additions of vapor recovery gasoline should be about the same as for natural gasoline.

The volatility of the motor fuel to which the ingredients are added is also of importance. For example, whereas butanized alkylate had very minor effects when added to 1951 summer regular gasoline it would have devolatilized 1941 winter premium gasoline and volatilized 1937 summer regular gasoline.

From Figure 10 it can be surmised that the butanizing effect accounts for much of the difference in volatility between summer and winter gasolines. The effect of greater winter additions of butane free natural gasoline (and vapor recovery gasoline) also accounts for part of the difference between winter and summer gasolines. The addition of heavy catalytic cracked naphthas, a means of simulating end point elevation, decreases the average volatility and is probably the chief factor contributing to the reversal in trends in the tail end volatility of premium gasolines.

Effect of Refinery Processes and Yields on Motor Fuel Volatility

This is an extremely complex question. Consider, for example, the trend in recent years toward rapidly increased distillate yields and almost as rapidly decreased fuel oil yields. What effect has this had on gasoline volatility? If no other change had taken place there might be some way of estimating the overall result of this one change. However, while this drastic change has been taking place there have been drastic changes in refining processes, i.e., vapor recovery, polyforming, catalytic polymerization, catalytic cracking, alkylation, and more recently catalytic reforming, solvent extraction and vacuum distillation. Over and above these there are extraneous factors such as variations in the quality of the crude oil supply, TEL shortages, and the growing proportions of motor fuel derived from the natural gas liquids.

In a situation so complex it is next

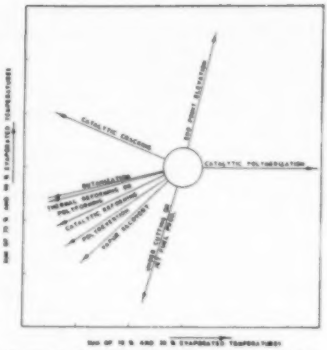


Figure 11. Effect of Refining Processes on Motor Fuel Volatility.

to impossible to be quantitative. However, Table 4 presents some data showing the volatility changes brought about by a number of refining processes in specific instances.

The directional effects on motor fuel volatility of these processes as deduced from the data of Table 4 and Figure 10 are indicated in Figure 11.

Only end point elevation and catalytic polymerization operations reduce average volatility. Catalytic cracking results in a comparatively small increase in average volatility represented by increases in both light and heavy fractions. Alkylation as mentioned earlier has very little effect. All the other refining operations result in rapidly increasing average volatility.

Results of Volatility Changes on Gasoline Performance

Figure 12 shows the relation of

TABLE 4
Effect of Some Refining Processes on Motor Fuel Volatility

REFINING PROCESS	Data Source	CHARGE			PRODUCT		
		Sum 10+30% Evap. Temp.	Sum 70+90% Evap. Temp.	RVP	Sum 10+30% Evap. Temp.	Sum 70+90% Evap. Temp.	RVP
A. Thermal Reforming of Mid-Continent 280 F—415F Straight Run Naphtha	Experimental	601	712		446	667	3.4
B. Catalytic Reforming of Mid-Continent 180 F—400F Straight Run Naphtha	Experimental	459	649		439	633	2.9
C. Polyforming with No Outside Gas of Venezuela 265 F—430F Straight Run Naphtha	[1]	597	690		368	638	7.5
D. Polyreversion with 100% Outside Gas of Mid-Continent 110 F—424 F Full Range Straight Run Naphtha	[1]	362	539		293	472	8.5
		FINISHED MOTOR FUEL					
		A. Before			B. After		
E. Substitution of Catalytic Gas Oil Cracking for Thermal Gas Oil Cracking and Its Effect on Finished M.F.	Refinery Operation	313	566	8.0	288	587	7.8
F. Increasing Refinery Total Distillate Yield from 42.7% to 56.3% (Based on Crude) by Production of 14.3% of Jet Fuel	Refinery Operation	324	652	9.2	308	599	9.0
G. Conversion of Refinery Propylene and Butylene to Catalytic Polymer and Inclusion in M.F. to the amount of 6%	Refinery Operation	269	562	8.9	278	561	9.0

[1] J. E. Bogk, P. Ostergaard, and E. R. Smoley, "The Naphtha Polyform and Gas Reversion Processes," Twenty-first Annual meeting, American Petroleum Institute, November 13, 1940.

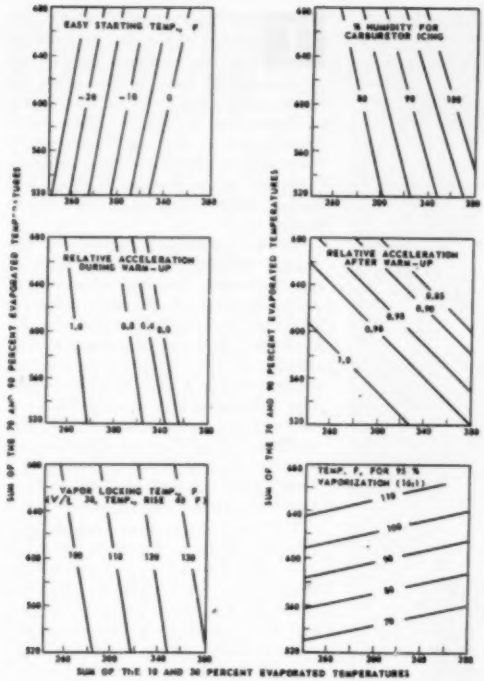
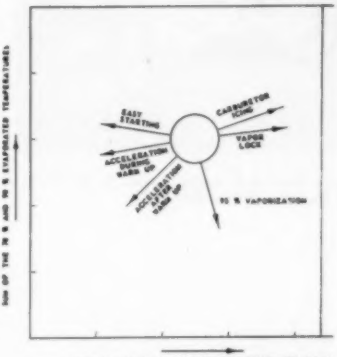


Figure 12 (left). Relation of Performance Characteristics to Gasoline Volatility.

Figure 13 (below). Summary of the Effect of Volatility Changes on Performance Features.


EASY STARTING
CARBURETOR ICING
VAPOR LOCK
ACCELERATION DURING WARM-UP
ACCELERATION AFTER WARM-UP
70 % VAPORIZATION
SUM OF THE 70 % AND 90 % EVAPORATED TEMPERATURES
SUM OF THE 10 % AND 30 % EVAPORATED TEMPERATURES

engine performance features to volatility in terms of the sums of the 10 + 30 and 70 + 90 percent evaporated distillation temperatures. While these two sums go a long way toward defining the entire distillation curve, the relationships shown have some of the usual limitations attending the use of the same simple expression of volatility to predict a variety of characteristics which are, in fact, predominantly controlled by the volatility of different fractions of the gasoline. Also, the relationships, as illustrated, apply to an "average car" and to specific environments; for example, easy starting to winter operation, vapor lock to summer operation, acceleration after warm-up to cool weather, and carburetor icing to an ambient air temperature of about 40° F. Despite these limitations on the quantitative interpretation of the illustrations of Figure 12, they are indicative, in most cars and most environments, of the qualitative effects of volatility changes on the major performance features dependent upon volatility.

Figure 13 summarizes these effects, the arrows pointing in the directions of improved performance. Comparison of this figure with Figure 8, clearly demonstrates that the increase in volatility over the period from 1937 to 1951 has resulted in improved performance except with respect to vapor lock and carburetor icing. Taking as an example average Gulf Coast regular winter gasolines and referring to Figure 12 for an approximate estimate of the magnitude of these improvements, 1937 performance during warm-up was poor (relative acceleration about 0.1) while by 1951 it had become good (relative acceleration about 0.8). Similar, though not as large, improvements are indicated for relative acceleration after warm-up which increased from about 0.9 to 0.98, in easy starting temperature which decreased about 6° F., and in 95 percent evaporated temperature which decreased about 12° F. In contrast to these improvements, the relative humidity for carburetor icing decreased about 9 percent over the same period. Also, in the case of average Gulf Coast regular summer gasolines the indicated decrease in atmospheric temperature for incipient vapor lock is 15° F. It is interesting to note that these volatility changes have resulted in the present summer gasolines being more volatile than 1937 winter gasolines so that the vapor locking temperature of an average Gulf Coast regular winter gasoline for 1937 is estimated to be about 4° F. higher than that for an average Gulf Coast regular summer gasoline for 1951.

The increases in carburetor icing and vapor locking tendencies unavoidably accompany the improvements in the other characteristics. The conflict between carburetor icing and acceleration cannot be reconciled by volatility changes because those required for an appreciable improvement in carburetor icing would result in unacceptable acceleration performance, particularly during warm-up. The conflict between vapor lock and easy starting during the seasonal transitions covering nearly half of the year, although nearly as difficult to reconcile, is handled by reasonably successful compromises requiring careful adjustments of volatility.

The trends toward increased gasoline volatility should be satisfactory on the whole to both the petroleum and automotive industries permitting greater flexibility in refinery operations and resulting in improved performance in the most important respects.

REFERENCE

*Detailed tabulations of the USBM survey data by areas, seasons, grades, and years, and detailed graphs for Figures 1, 2, and 3 can be obtained on request to the authors, as long as the supply lasts.

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[4] Moxey; "Engine Warmup with Present-Day Fuels and Engines"; SAE Transactions, 1947, p.441.

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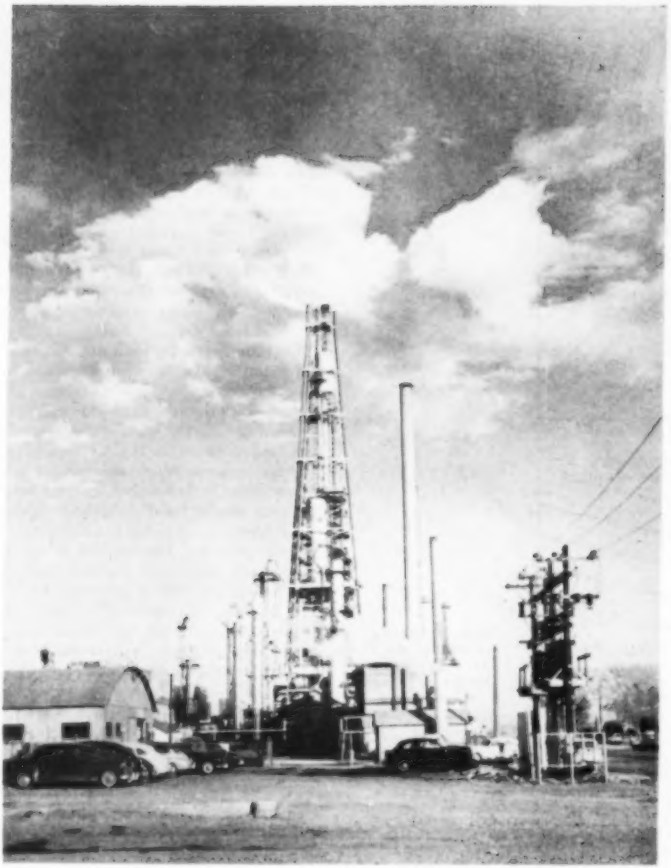

Package-Type TCC Unit of New Mexico Asphalt and Refining Company, Artesia, N. M., Showing How Vessels Are Supported by Steel Drilling Derrick.

First Package-Type TCC Unit Completes Six Months Operation

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THE first of the "packaged" air-lift TCC units, designed to provide catalytic gasoline on an economical basis in the small refinery, completed its initial six months of operation in March. This 6000-barrel-per-day unit was installed by New Mexico Asphalt and Refining Company at its Artesia, N. M., plant during their recent modernization project.

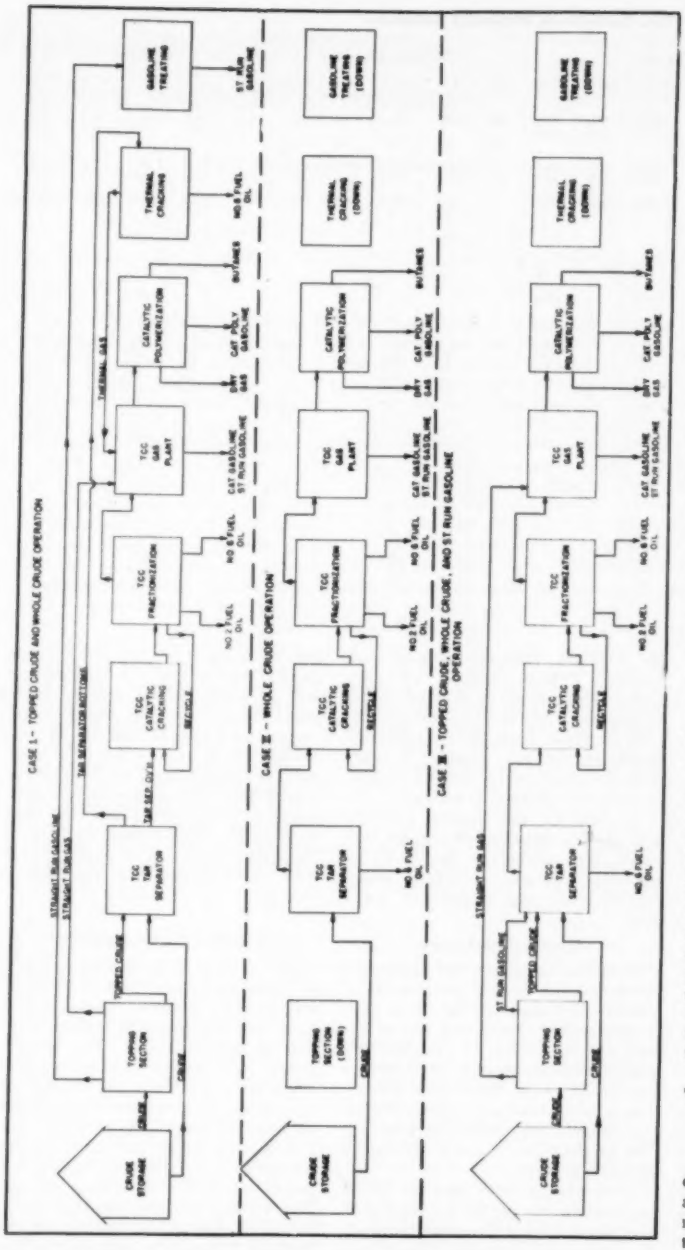
The oil processing facilities at the Numex Refinery after completion of the expansion program consisted of crude distillation, thermal cracking, TCC catalytic cracking, catalytic polymerization and gasoline treating. The existing facilities of crude distillation, thermal cracking and gasoline treating were integrated with the new TCC and catalytic polymerization units to give maximum flexibility of operation so that the Numex Refinery could meet wide variations in market requirements or product specifications.

TCC feed preparation sections provide flexibility to handle a large variety of charge stocks. Hence the Numex TCC unit, with its attendant tar separation feed preparation unit, can be operated on virgin gasoil, topped crude, whole crude, naphtha, straight run gasoline, or mixtures of these stocks. Likewise, customary provisions have been made so that the unit can handle the recycle gasoils from the catalytic cracking operation on the above stocks. Enough heat exchange equipment has been installed to permit cold operation from tankage or hot operation from the thermal and distillation units.

The operating history of the Numex TCC unit for its first six months has demonstrated that more than the designed operating capacity is available to the refinery. Moreover the TCC unit has demonstrated flexibility for handling a wide variety of charging stocks since the charging stock to the TCC unit was changed frequently and easily during the first few months of operation without disturbing efficient operation. These changes which were made during the first six months of operation to meet changes in crude production schedules, in local marketing conditions, and in product specifications are noted below:

Gasoil and Whole Crude Operation

For the start-up operation, gasoil from storage was charged to the feed preparation section of the new TCC unit along with whole crude. The whole crude consisted of a mixture from the Hobbs and Longlie Mattox fields in New Mexico. This crude con-



taining a minimum of 1.5 and a maximum of 2.0 weight percent sulfur, has an API gravity of 33, and contains 30 volume percent of straight-run gasoline. It is a typical sour West Texas crude. The gasoil was a mixture of straight-run and thermal gasoils, which were stored prior to the start-up of the TCC unit.

Topped Crude, Whole Crude and Partial Straight-Run Gasoline Operation

After the gasoils in storage were depleted, the thermal unit was charged with tar separator bottoms for visbreaking to No. 6 or bunker fuel specifications. The available charge for catalytic cracking was then less than the nominal capacity of the unit. The catalytic cracking unit was kept to capacity by increasing the amount of whole crude sent to the tar separator of the TCC unit, and also by the introduction of reduced crude to the tar separator. The amount of topped crude available for catalytic cracking was limited by the market requirements for middle distillates, as only the amount of crude necessary for these products was charged to the distillation unit.

Whole Crude Operation

A change in product requirements made it desirable to run with 100 per cent whole crude charged to the tar separator of the TCC unit. This operation also made it possible to effect a savings by shutdown of the crude distillation, gasoline treating and thermal cracking facilities for maintenance turnaround without reducing gasoline quality or decreasing crude run. It should be mentioned here that the original modernization program in the refinery had not included any additional facilities for gasoline treating. Therefore, since the crude run was doubled, it was necessary to plan that excess straight-run gasoline would be charged to the TCC unit to take advantage of its desulfurizing abilities. It is of considerable commercial significance to note that not only was the straight-run gasoline satisfactorily desulfurized by the TCC operation, but also the operation was further justified by the increase in clear octane numbers obtained on the straight-run gasoline. The whole crude operation on the TCC indicated that in addition to the desulfurization which gave increased lead susceptibility, the straight-run gasoline was improved by 13 Research, clear, octane numbers when charged to the TCC instead of to the gasoline treating plant.

Topped Crude, Whole Crude and Total Straight-Run Gasoline Operation

The octane number improvement demonstrated in the whole crude operation for processing the straight-run naphtha was used to advantage when the crude distillation units were placed back in service, which became necessary to produce some straight run kerosene and diesel products. Under this operation the middle distillate products were obtained by sending to the crude distillation units the minimum amount of crude required for these straight-run products. Then the charge to the TCC unit itself consisted

TCC Section on Material Balances

CHARGE	CASE I					CASE II					CASE III				
	°API	B/D	Mlb./D	Vol. %	Wt. %	°API	B/D	Mlb./D	Vol. %	Wt. %	°API	B/D	Mlb./D	Vol. %	Wt. %
St.-Run Gasoline to TCC Tar Separator											59.0	883	229.6	17.5	15.8
Crude to TCC Tar Separator	33.9	3,470	1,037.0	89.0	86.7	34.0	5,800	1,735.0	115.5	118.9	34.6	4,140	1,233.7	82.2	84.9
Topped Crude to TCC Tar Separator	21.9	2,055	664.0	52.6	55.5						21.7	1,317	425.4	26.2	29.3
Gas Oil to TCC Tar Separator						39.5	230	66.5	4.6	4.6					
Total to TCC Tar Separator		5,525	1,701.0	141.6	142.2		6,030	1,801.5	120.1	123.5		6,340	1,888.7	125.9	130.0
Tar Separator Bottoms Make	15.7	1,625	546.0	41.6	45.7	14.8	1,012	342.0	20.1	23.5	13.5	1,306	445.3	25.9	30.6
Fresh Feed to TCC Reactor		3,900	1,155.0	100.0	96.5		5,018	1,459.5	100.0	100.0		5,034	1,443.4	100.0	99.4
Recycle Feed to TCC Reactor		1,335					1,380					1,440			
Total Feed to TCC Reactor		5,235					6,398					6,474			
Thermal Gas to TCC Gas Plant			27.3		2.3										
St.-Run Gas to TCC Gas Plant			14.1		1.2								9.2		0.6
Total to TCC			1,196.4		100.0								1,452.6		100.0
PRODUCTS:															
Debutanized TCC Gasoline (420° F. End Point)	54.7	2,560	681.0	65.7	57.0	54.8	3,420	910.0	68.1	62.4	54.4	3,626	964.5	72.0	66.4
Cat. Poly Gasoline (435° F. End Point)		301	78.2	7.7	6.5		229	59.5	4.6	4.1		199	51.7	4.0	3.6
Butanes to Gasoline Blending		278	55.6	7.1	4.6		317	63.4	6.3	4.3		378	75.6	7.5	5.2
No. 2 Fuel Oil (520° F. End Point)	32.0	335	101.5	8.6	8.5	31.0	460	140.2	9.2	9.6	28.3	422	130.8	8.4	9.0
No. 6 Fuel Oil	16.9	309	103.2	7.9	8.6	15.3	318	107.1	6.3	7.3	13.1	190	65.0	3.8	4.5
Refinery Fuel Gas			81.3		6.8			94.0		6.4			73.2		5.0
Coke			79.2		6.6			77.0		5.3			79.2		5.5
Total Products		3,783	1,180.0	97.0	98.6		4,744	1,451.2	94.5	99.4		4,815	1,440.0	95.6	99.2
OCTANES:[1]															
Research Clear			79.2[1]					82.0[1]					81.0[1]		
OPERATING CONDITIONS:															
Catalyst to Oil Ratio Vol.			5.7					4.7					4.6		
Space Velocity V/Hr/V			0.8					0.97					0.98		
Recycle Ratio V Rec/V F.F.			0.34					0.28					0.29		
Catalyst Activity Index			34.5					33.5					32.0		
Average Reactor Temperature °F.			833					850					850		
Vapor to Reactor Temperature °F.			763					770					775		
Catalyst to Reactor Temperature °F.			908					950					952		

[1] Includes large amounts of straight-run gasoline.

of whole crude, topped crude and straight-run gasoline. Additional capacity in the TCC unit was utilized by recycling catalytic gasoil.

Flow Diagrams

By way of illustration, block flow diagrams giving the flow of major refinery streams for the last three operating cases are shown on the opposite page.

Thus, in Case I all the refinery oil processing facilities are in use. Part of the crude oil flows to the topping section of the plant and a part flows directly to the tar separator section of the TCC unit. The straight-run gasoline and the gasoil from the tar separator pass to the TCC reactor. The gasoline product goes through the usual processing. The straight-run gasoline from the topping section is charged directly to the gasoline treater. The wet gases from topping and thermal cracking are sent to the gas plant section of the TCC unit. The gas from the TCC gas plant is sent to the catalytic polymerization section where dry gas, butanes for gasoline blending, and catalytic polymerization gasoline are produced. The tar separator bottoms are cracked thermally to heavy fuel.

Case II differs from Case I in that the topping, thermal cracking and gasoline treating sections are shut down. Whole crude is charged to the tar separator of the TCC unit and the total overhead from the tar separator passes to the TCC reactor. The tar separator bottoms go directly to fuel instead of to thermal cracking.

In Case III the thermal cracking and gasoline treating sections are shut down. The charge to the TCC tar separator consists of whole crude, topped crude and straight-run gasoline.

Material Balances

Material balances and operating conditions for the TCC section of the refinery for each of the three flow diagram cases mentioned above are shown in the tables. The product volume and weight balances are based on the TCC reactor fresh feed charge. The refinery fuel gas contains the excess butanes not needed for blending. The product gasoline was blended to 10.5-pound Rvp.

It should be noted that the octane numbers shown are for the total gasoline streams from the catalytic cracking sections of the plant. These gasoline streams include, in all cases, large amounts of straight-run gasoline. Thus, Case I includes the straight-run gasoline present in the whole crude charged to the TCC tar separator as well as some thermal cracked products from the Thermal Unit wet gas stream. In Cases II and III all the straight-run gasoline from all the crude being processed by the refinery is included. The average reactor temperatures in Cases II and III were considerably higher than in Case I. Thus the octane values reported for these cases exceed that reported in Case I.

Catalyst Consumption

The TCC catalytic cracking section operates on Socony synthetic bead catalyst. The catalyst attrition losses have been low from the initial operation of the TCC unit. The average catalyst loss for the first six months operation is 1.22 tons per stream day or approximately 0.4 pound per barrel of reactor charge. The catalyst attrition loss for the second three months operation is 1.0 ton per day or 0.3 pound per barrel of reactor charge. This normal attrition rate has maintained an equilibrium catalyst activity level of 32 which is optimum for the refinery. Additionl catalyst make-up is not required to maintain a satisfactory equilibrium catalyst activity.

* * *

Extractive Crystallization—A New Separation Process

Part III. Practical Applications

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AS A NEW TOOL for petroleum and petrochemical processing, extractive crystallization shows promise for the separation of close boiling isomers and for other special refining problems. Urea selectively forms crystalline adducts with straight-chain types of compounds while thiourea selectively forms similar complexes with many branched-chain and certain ring-type compounds. Once the crystalline complex is formed, it is removed from the reaction mixture, and the crystals are dissolved in water, destroying the complex: the reactant is then recovered as an immiscible organic layer.

Parts I and II of this series dealt with a theoretical discussion of material related to the formation of the crystalline urea and thiourea adducts. Part III includes practical applications and a description of the new process.

MANY of the practical applications of urea and thiourea complex formation are apparent from the theoretical discussion and thermodynamic considerations of Parts I and II. Crude petroleum will, no doubt, continue to be fractionated in conventional equipment. The initial application of extractive crystallization will probably be restricted to separation of close boiling isomers and to special refining and separation problems. However, it opens a new field of operations in this respect. It must be understood that extractive crystallization is still a new process, and all of its possibilities have not yet been recognized. It may be expected that as more experience is gained with the process, it will find extensive use in the petrochemical industry in effecting separations which are now difficult or almost impossible from a practical standpoint.

Fetterly[10] suggests numerous possible uses. Certain petroleum refining operations can be simplified by subjecting feed streams to extractive crystallization to remove either napthenes or paraffins, as the case may dictate, thereby cutting down by-product formation. Terpene hydrocarbons can be relatively easily separated from the mixture of materials normally present in pine oil. Similarly, the coal tar industry may be able to realize an appreciable degree of separation of some of its products without subjecting them to severe heating.

In specialty products, such as medicinals, household sprays, and hydrocarbons for many chemical purposes, it is highly desirable, and at times essential, to be able to use hydrocarbons having substantially no color. Present methods of such purification are complex and expensive; extractive crystallization can be used definitely to advantage in this connection.

The use of certain hydrocarbons as fumigant carriers or in special chemical processes is difficult at times, because of their liquid state and volatility characteristics. A crystalline material containing specific hydrocarbons from which these hydrocarbons could be separated at will, or under controlled conditions, would be of use for many purposes.

Bengen[5] points out that this method can be used in the decomposition of essential oils. For example, methylnonyl ketone may be separated from rue oil through the use of urea adduct formation.

The process may prove useful in the production of lubricating oils, since straight chain components generally have properties which are desirable in lubricating oils.

The process may further be applied to the removal of higher paraffins from gasoline stocks, leaving behind branched-chain compounds which serve to raise the anti-knock rating of gasoline.

It readily becomes apparent that the application of a process involving formation of adducts of urea and its analogues is not restricted to large scale applications, such as are encountered in the petroleum industry. On the contrary, the process may well be applied to simplify purification of chemicals derived from wood oils and other natural sources. It may be utilized in the separation of some of the fatty acids; it is effective in raising the iodine number of drying oils. Schlenk and Holman[30a] observed that fatty acids combined in urea adducts did not develop characteristic odors of rancidity. This led to studies which showed that fatty acids can be protected from oxidation for extended periods of time when combined as urea adducts. Linoleic acid recovered from its adduct after standing one month in exposure to air was found to be unaltered. The fact that carbon tetrachloride vapor forms an adduct with dry thiourea suggests the use of adduct formation in the recovery of certain volatile solvents. A recent British patent[14b] pertaining to thiourea adducts suggests other possible uses. It is likely that extensive use of the extractive crystallization process will open still more fields for its application.

Analytical Applications

In the application of urea and thiourea complex formation to analytical methods, consideration must be given to temperature, presence of interfering substances and to equilibrium factors. Zimmerschied et al.[38] have studied hydrocarbon analysis by complex formation and have reported favorable results. They point out that there are certain limitations, and there is need for further development; nevertheless, the extraction technique provides a useful tool to simplify the task of analyzing complex fractions.

A qualitative test to determine presence of paraffins of more than six carbons can be run in a few minutes. Quantitative tests require a longer reaction time, up to several hours, to assure complete reaction. Among the higher paraffins (above C_{10}), recoveries in excess of 99 percent of the paraffin content of narrow mixture, have been realized. The *n*-paraffin content of narrow fraction virgin naphthas, of catalytic cycle oils and of heavy petroleum stocks and natural waxes can be reasonably well determined by formation of urea complexes. Methods may also be developed for alcohol, acid or ester determination when the desired molecules are long straight chains.

Because of the relative instability of thiourea adducts at room temperature, it appears that urea adducts will be more applicable as an analytical tool than will thiourea adducts. The disadvantage of having several hours required to assure complete reaction can

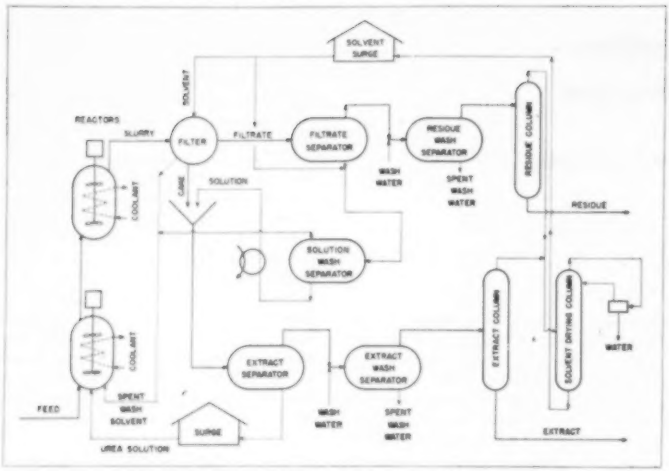

Figure 17. Simplified Flow Diagram of Extractive Crystallization Process.

often be overcome by carrying out the analyses at lower temperatures. Until more information is published concerning the use of adduct formation in analysis, it will be necessary for each laboratory either to develop new analytical procedures or to verify existing techniques for each new type of mixture to be analyzed.

A Process for Petroleum Hydrocarbons

Bailey et al.[4] have presented general information concerning a process designed for commercial application to hydrocarbons above the gasoline range. The name "Extractive Crystallization" has been adopted by Shell Oil Company to describe the selective recovery of compounds of specific structural types by urea and its analogues.

A study of various solvents led to the discovery that the lower molecular weight ketones, along with water, have special advantages in the application of the urea reaction to continuous operation. The choice among the several members of the ketone series depends on the boiling range of the feed stock as well as other considerations. Methyl isobutyl ketone is suitable for hydrocarbon mixtures ranging from heavy naphtha to lubricating oil.

It was first believed that methyl isobutyl ketone enhanced the reaction rate of normal paraffins with urea in water by increasing the solubility of the paraffins in the aqueous phase. However, Fetterly[11] cites evidence to indicate that the solubility influence is of little significance. In view of his concept of a solvated husk being formed in the liquid phase, he believes that the increased reaction rate is "due to: a) a reduction in the strength of the water or surface monolayer by hydrogen-bond interaction without the formation of a new bulky film barrier and b) formation of a more linear chain configuration which has greater probability of reaching and passing through the interphase on kinetic collision."

Bailey et al. state that in the extractive crystallization process, the aqueous phase is kept substantially saturated with urea during and after reaction, by taking advantage of the high temperature coefficient of solubility of urea in water. A suitable amount of urea solution, saturated at a temperature higher than the intended final reaction temperature, is admixed in the reactor with the feed and the organic solvent, and sufficient cooling is provided to remove sensible heat as well as the heat of reaction. For example, a feed stock may be considered from which 15 percent *n*-paraffins is to be removed by reaction with urea using three volumes of solution per volume of feed. In order to maintain the solution saturated under terminal conditions, it is then sufficient to have the original solution saturated at a temperature 15° F. above the terminal temperature.

In Figure 17 is shown the simplified flow diagram, presented by Bailey et al.,[4] of the extractive crystallization process as designed for application to hydrocarbons above the gasoline range. Some of the fine details of the process are not shown in the diagram for the sake of simplicity; however, as will be seen later, the principles shown here are generally applicable to almost any separation involving urea adduct formation. The process presented here involves the use of urea in a water solution along with methyl isobutyl ketone as an organic solvent. This is essentially a fluid process, with the only solids involved being the make-up urea and the crystalline urea-hydrocarbon adduct itself.

As shown in the diagram, the streams charged to the reactor are the hydrocarbon feed containing some paraffinic fractions which are to be extracted, the urea solution, and the ketone solvent. The reactor section may consist of several stages, depending upon the degree of approach to equilibrium which is being sought. Inasmuch as it is desirable to maintain the urea solution saturated during the reaction, as discussed in connection with Figure 16 (Part II), it is necessary to supply sufficient urea to compensate for that utilized during the reaction. This can be accomplished by supplying the urea solution to the first reactor at an elevated temperature and then progressively reducing the temperatures in the successive stages. The heat transfer surfaces provided serve to remove the small heat of reaction and to reduce the sensible heat initially provided. Each stage is equipped for intensive mixing because of the two liquid phases which are present and the crystalline adduct which is formed.

The slurry leaving the reactors includes the crystalline adduct and the two-phase liquid system consisting of: a) the aqueous urea solution and b) the organic layer containing the unreacted hydrocarbons, termed the residue, plus the ketone solvent. The crystalline complex may be recovered by filtration, centrifuging, or in special cases by simple settling. A filter is shown in the flow diagram. The crystalline complex is washed with fresh ketone solvent to remove entrained residual hydrocarbons, and the spent wash solvent is then used as the organic solvent in the reaction step.

The filtrate goes to the filtrate separator from which the solution of ketone solvent and residual hydrocarbons is removed as the upper layer and the aqueous urea solution is withdrawn as the lower phase. The upper ketone layer is washed with water to remove a very small amount of dissolved and entrained urea, and it then passes to the residue column for solvent recovery. The residue, which has been made lean in paraffinic fractions, is now available for further processing toward its desired uses. The urea solution from the filtrate separator may be washed with fresh ketone solvent to remove traces of dissolved or entrained hydrocarbons, and this mixture is sent to the solution wash separator for separation of the ketone and aqueous phases. The ketone layer is then

combined with the spent wash solvent which is fed to the reactor section.

The aqueous urea solution from the wash separator is combined with the washed filter cake of urea adduct, sufficient heat being supplied to bring the temperature of the mixture to 40°-70° F. above the reaction temperature. The crystalline complex dissociates under these conditions; the straight-chain hydrocarbons, which constitute the extract, are liberated as an oil phase, and the urea is returned to the aqueous solution. The two phases are then separated in the extract separator. The aqueous urea solution is withdrawn as the lower layer and sent to a surge tank for reuse as the urea solution charged to the reactor section. The upper extract phase, which contains some ketone solvent which was included in the filter cake, is washed with water and sent to the extract wash separator. From here, the washed extract phase passes to the extract column for removal of solvent from the paraffinic extract.

Distillation is employed for solvent recovery in the extract and residue columns. Steam may be injected into the bottoms of the columns, where advisable, to improve solvent recovery. The solvent is then sent to a solvent drying column from which it goes to a surge tank for reuse in the process.

Bailey et al. point out that many of the process details have been omitted. For example, the extract and residue water washes may consist of two countercurrent stages each, as a means of reducing water usage. Also, solvent is recovered from the spent wash water, heat exchange is employed between the filtrate and the initial reactor stages to reduce the cooling load, and the rotary filter is housed and maintained in an atmosphere of inert gas as a safety measure.

Operating Factors

The process conditions which are selected must depend upon the type of feed processed and the result desired. The temperature employd for any separation for which the process is applicable would be expected to be relatively easily attained. As an example of the magnitude of some of the process variables reported by Bailey et al., Table 7 illustrates typical conditions employed when processing a straight run stove oil from Los Angeles Basin crude, containing 12 percent *n*-paraffins.

Mixing intensity and the solvent-to-feed ratio appreciably influence the reaction rate and crystal size. When the slurry is produced under the proper conditions, the crystal needles will be about 0.1 millimeters in length and will be free filtering. A typical cake volume is reported to be about 50 cubic feet per barrel of *n*-hydrocarbons extracted. The heat transfer surface required is on the order of 1.0 to 1.5 square feet per daily barrel of feed.

TABLE 7
Typical Operating Conditions for Straight-Run Stove Oil

(*n*-paraffin Content = 12 percent by Volume)

Final reaction temperature	80° F. (27° C.)
Regeneration temperature	140° F. (60° C.)
Initial saturation temp. of urea solution	95° F. (35° C.)
Urea solution circ. rate, gal./gal. feed	3
Solvent circ. rate (methyl isoamyl ketone), gal./gal. feed	0.7
Reactor residence time, minutes	12
Filter surface, sq. ft. per bbl. feed per day	0.3

The urea solution exhibits a tendency to corrode steel in the presence of air, but this may be overcome by the addition of an inhibitor. Construction of the equipment may be of mild steel throughout, except that it is desirable for some of the filter parts to be of stainless steel. It is cautioned that copper-bearing metals should be avoided, because they are attacked by urea and by the ammonia which is formed as a hydrolysis product. The ketone solvent affects rubber and certain synthetic plastic materials; accordingly, care must be taken in the selection of gasket and hose materials.

Once the process is put into operation, chemical consumption is limited primarily to replacement of losses. Hydrolysis of urea is a significant factor, and it has been found that the rate of hydrolysis is approximately doubled for each 10° F. increase in temperature. However, this does not represent an excessive cost factor; hydrolysis rates in the range of 0.1 to 1.0 pound of urea per barrel of feed have been experienced. The current cost of urea is around six cents per pound.

The purity of the final product will depend largely upon the efficiency of washing the filter cake. Purity as high as 99 percent *n*-paraffins can be attained under the proper conditions, and purities on the order of 96 percent appear to be readily obtained. Inasmuch as reactivities of some slightly branched compounds are sometimes influenced by the presence of long *n*-paraffins, the degree of purity of the final extract is also dependent upon the composition of the feed stock.

It can be seen from the flow diagram that, to a great extent, conventional equipment is employed in the process. Also, the operating costs of a process such as that described here could be expected to compare favorably with those effecting comparable separations. In many cases, separations can be carried out by extractive crystallization which are not economically feasible by any other process.

Garner et al.[12] point out that the urea complex crystals are oleophilic in character, and because of this property and also because of the small crystal size encountered in some cases, there is sometimes a tendency for the crystals to associate with the unreacted hydrocarbon phase rather than settling into the aqueous phase, as would be more desirable. Thus, in regenerating normal paraffins from their molecular urea complexes, difficulty is sometimes experienced in obtaining a sharp separation between the regenerated hydrocarbon phase and the aqueous regenerating medium.

Garner et al.[12] have been issued a patent for a means of overcoming this problem. This is accomplished by the addition of a water-soluble wetting agent together with a water-soluble, substantially neutral electrolyte (i.e., does not change the pH of the solution from the desirable operating range of 2.5 to 9.5). This treatment causes the finely divided crystals to associate with the aqueous phase and simultaneously depresses emulsification of the remaining liquid hydrocarbon phase in the aqueous medium, thus facilitating the separation of the two phases.

Application to Oil and Fatty Acid Separation

The principles of extractive crystallization adapt themselves well to separations of materials other than petroleum hydrocarbons—even to some mixtures where all of the components present react with urea to form adducts. Many unsuccessful attempts have been made to obtain pure fatty acids from a mixture by crystallization. Fetterly[11] points out that the mutual solubility effect of one acid on the other, causing a shift in the equilibrum line, is responsible for the difficulty or impossibility of obtaining a pure fatty acid from a mixture by crystallization methods. However, use of the urea crystallization process can provide a good degree of separation through the use of relatively simple equipment. As pointed out by Newey et al.,[14a] presence of double bonds apparently causes chain-molecules to deviate from the linear form by sufficient amount so that they no longer fit easily into the urea crystal structure. In the case of fats and oils, if a mixture contains two or more complex-forming substances, separation is frequently possible because of differences in reaction rates. For example, both stearic and oleic acids form adducts with urea but the saturated stearic acid ($C_{17}H_{35}COOH$) reacts to form an urea adduct much more rapidly than does oleic acid ($C_{17}H_{33}COOH$) with its double bond. Similar differences exist for drying oils, depending upon

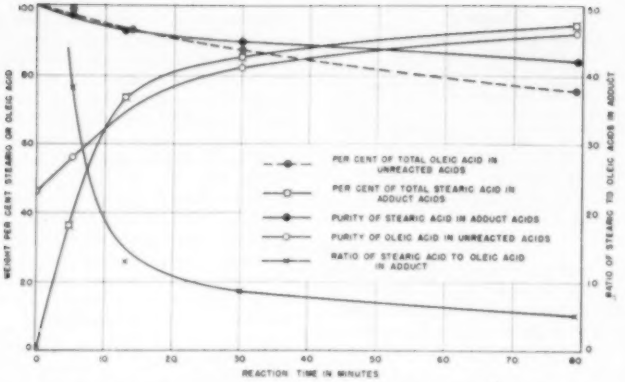
WEIGHT PER CENT STEARIC OR OLEIC ACID
RATIO OF STEARIC TO OLEIC ACIDS IN ADDUCT
REACTION TIME IN MINUTES
PER CENT OF TOTAL OLEIC ACID IN UNREACTED ACIDS
PER CENT OF TOTAL STEARIC ACID IN ADDUCT ACIDS
PURITY OF STEARIC ACID IN ADDUCT ACIDS
PURITY OF OLEIC ACID IN UNREACTED ACIDS
RATIO OF STEARIC ACID TO OLEIC ACID IN ADDUCT

Figure 18. Example Separation of Stearic and Oleic Acids by Urea Adduct Formation.

the degree of unsaturation.

Fetterly presents an example separation of stearic and oleic acids using batch reaction data. This is presented in graphical form in Figure 18. Benzene was used as a solvent for the fatty acids in this study. The starting mixture was a 56/44 weight ratio of stearic and oleic acids, and the urea was used with water as the solvent. Thus, a two phase liquid system was realized. It was found that after five minutes, 40 percent of the total stearic acid had reacted to form a complex having a stearic acid purity of 97.5 percent. This represents a separation ratio of 37 to 1. After two hours, the pseudo-equilibrium purity of the adduct had dropped to 88 weight percent stearic acid, giving a separation ratio of only 4.5 to 1. At this point, 95 percent of the total stearic acid had reacted. It was found that the optimum purity-yield balance for both the stearic and oleic acid fractions was obtained after about 20 minutes contact time.

The progress of the reaction may be followed on the curves shown in Figure 18. The starting reaction conditions were as follows:

Starting temperature	80° F.
pH of urea solution	6.5
Starting urea concentration in water soln.	60.1 g./100 ml.
Starting acid concentration in benzene soln.	9.15 g./100 ml.
Stirring rate, revolutions per minute	1400
Ratio of urea soln. to benzene soln. (vol.)	2:1

When a separation is made with a view to upgrading the iodine number of an oil mixture, it will be found that a maximum will be reached. The saturated fraction tends to form an adduct, thereby increasing the iodine number of the unsaturated fraction which has a lower reaction rate and tends to remain in the liquid phase. However, after the optimum time, the iodine number of the unreacted phase will begin to fall off as more and more of the unsaturated compound reacts to form an adduct.

Fetterly points out that when an acid mixture contains linolenic acid, as in soybean mixtures, the very unreactive linolenic acid remains almost completely in the residual oil fraction. A soybean mixture having a starting iodine number of 122 was upgraded to 175 after five minutes reaction time with a saturated urea solution at 25° C., but dropped to 154 when the reaction was allowed to continue.

The temperature at which the reaction is conducted for extraction of drying oils does not appear to be critical as long as the adducts are stable. This is a great convenience for conducting the process on an industrial scale. In general, the reaction rate is higher at lower temperatures. For example, the reaction rate with oleic acid was approximately the same at 35° C. as at 25° C., but it was slightly higher at 0° C. Fetterly indicates that factors other than reaction rate and equilibria will govern the selection of an optimum operating temperature in a urea-fatty acid process.

In Figure 19 is shown an example extractive crystallization process as presented by Fetterly[11] for the separation of fatty acids. This is a modification of the process shown in Figure 17 for hydrocarbons. By this process, an inexpensive soybean mixture can be upgraded sufficiently to yield a new oil fraction having drying properties comparable with linseed oil for use in paints and varnishes. Removal of a large part of the non-drying fraction from linseed acids will improve the drying properties of this oil to a point approaching that of tung oil. Salmon oils and tall oil also show better drying properties by urea treatment. Fetterly also points out that urea does not react with odoriferous compounds in fish oil; accordingly, it is possible to obtain odor-free oil fractions from fish oils which in the past have had limited applications because of their undesirable odors.

A discussion of the segregation of fatty acids and their derivatives by Extractive Crystallization is presented by Newey et al.[14a] This work is based in part on the work done by Fetterly.[11] It is pointed out by Newey et al. that it is also possible to use dry crystalline urea with the fatty acid feed in the reaction step. In this case the organic component in the adduct is recovered by decomposition of the crystalline complex by using an excess of a urea solvent in the same manner as for the fluid process.

The general characteristics of simple equipment, convenient operating temperatures, fluid systems at low pressure, and use of relatively inexpensive urea or thiourea which can be recycled, make extractive crystallization an attractive process which is destined to find many varied applications in large and small industries alike.

Demonstration Experiments of Adduct Formation

Several demonstration experiments have been devised so that anyone having access to the proper materials may see for himself how readily the urea and thiourea adducts are formed. Test tube quantities of the organic reactants are sufficient for these experiments. The formation of the adducts is generally instantaneous, at least to a certain degree of completion, and the experiments are designed to show in a striking manner the reactivity and selectivity of urea and thiourea toward certain organic compounds. It has been found that solutions of urea and thiourea in methanol are better for demonstrations of complex formation than aqueous solutions. Aqueous solutions may be used; however, the aqueous urea solution requires a certain amount of temperature control because of the high solubility of urea in water and because of the high temperature coefficient of the solution.

A saturated solution of urea in water plus *n*-octanol gives crystals at the interface. This is essentially the combination which Bengen had when he accidentally discovered the crystalline complex. This reaction mixture is temperature sensitive. If the temperature is lowered a few degrees, the entire mixture will crystallize, whereas if the temperature is raised a few degrees, all of the crystals will dissolve. This test is presented here because of its historical connection with the process.

Action of Urea

Urea is selective to long straight-chain compounds; it will not react with highly branched compounds. This

is demonstrated by the following experiments:

1) A saturated solution of urea in methanol plus isooctane gives no precipitate.

2) A saturated solution of urea in methanol plus isooctane plus a long straight-chain hydrocarbon (C_{10} or above) gives a crystalline complex immediately, composed of urea and the straight-chain hydrocarbon.

Action of Thiourea

Thiourea complements the reactions of urea with organic compounds. Thiourea will not react with long straight-chain compounds, but contrary to the behavior of urea, thiourea reacts with certain cyclic and highly-branched compounds.

1) A saturated solution of urea in methanol plus methyl cyclohexane gives no precipitate.

2) A saturated solution of thiourea in methanol plus methyl cyclohexane gives crystalline complex formation immediately.

3) A saturated solution of thiourea in methanol plus a long paraffin, such as hexadecane, gives no precipitate, but when carbon tetrachloride is added, a crystalline complex forms immediately between carbon tetrachloride and thiourea.

Dissociation of Adducts

The crystalline complex is dissociated by heating or by being mixed with water. As a rough comparison with the industrial application, a warm saturated solution of urea in water added to a mixture of isooctane and long straight-chain hydrocarbons gives a crystalline complex consisting of the normal hydrocarbons and urea. Cooling may be employed to control the small heat of reaction. The slurry is filtered and washed; acetone may be used as the washing agent in this demonstration in order to remove any extraneous hydrocarbons which would be immiscible with water. The crystals, which have been washed free of any occluded insoluble hydrocarbons, are then mixed with water, causing dissociation of the complex as evidenced by the dissolving of urea in water and by the layer of long straight-chain hydrocarbons which forms above the water.

ACKNOWLEDGMENT

The authors wish to thank the various authors and publishers of material referred to in this series of articles for their splendid cooperation.

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Figure 13 is redrawn by permission of the American Chemical Society.

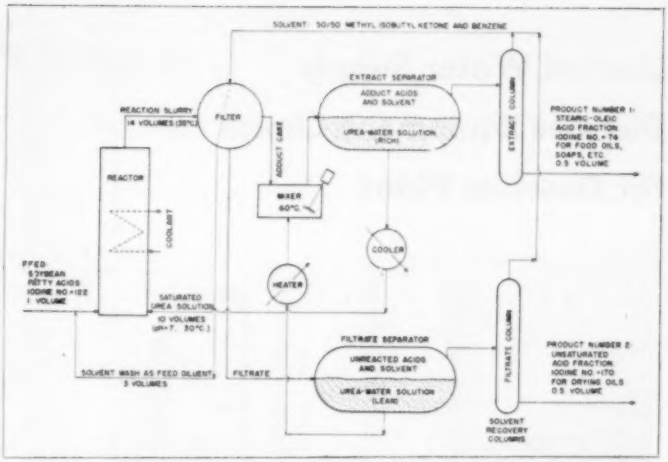
SOLVENT: 50/50 METHYL ISOBUTYL KETONE AND BENZENE
EXTRACT SEPARATOR
ADDUCT ACIDS AND SOLVENT
UREA-WATER SOLUTION (RICH)
EXTRACT COLUMN
PRODUCT NUMBER 1: STEARIC-OLEIC ACID FRACTION IODINE NO. + 76 FOR FOOD OILS, SOAPS, ETC. 0.5 VOLUME
REACTION SLURRY (4 VOLUMES (50°C.)
FILTER
ADDUCT CAKE
REACTOR
COOLANT
MIXER 60°C.
COOLER
HEATER
FEED SOYBEAN FATTY ACIDS IODINE NO.=132 1 VOLUME
SATURATED UREA SOLUTION 10 VOLUMES (65-7, 50°C.)
FILTRATE SEPARATOR
UNREACTED ACIDS AND SOLVENT
UREA-WATER SOLUTION (CLEAR)
FILTRATE COLUMN
PRODUCT NUMBER 2: UNSATURATED ACID FRACTION IODINE NO.=170 FOR DRYING OILS 0.5 VOLUME
SOLVENT WASH AS FEED DILUENT, 3 VOLUMES
FILTRATE
SOLVENT RECOVERY COLUMNS

Figure 19. Flow Diagram of Extractive Crystallization Process for Separation of Fatty Acids.

Figure 17 is redrawn by permission of Industrial and Engineering Chemistry.

The authors also wish to acknowledge with thanks the advice and comments from Dr. Lloyd C. Fetterly. Figures 18, 13 and 19 are redrawn from Dr. Fetterly's Ph.D. Thesis.

ADDENDUM

Several patents pertaining to extractive crystallization which have been issued since this series of articles was submitted for publication are cited here because of their bearing on the process.

Fetterly[40] suggests a means for improving the degree of separation of some mixtures through the use of selective solvents. If aromatics are present in a mixture, a selective solvent for the aromatics may remove them from the mixture while fractionation of the non-aromatic portion is being effected by urea or thiourea complex formation. The solvent may be an alcohol modified by the addition of 5 to 50 percent of such agents as ethanolamines, acetamide, phenol, nitrobenzene and aniline. Other suitable solvents include furfural and liquid sulfur dioxide.

According to another patent,[41] the fractionation of a hydrocarbon mixture may be accomplished through complex formation in the presence of such solvents as acetic anhydride, liquid nitrogen dioxide or liquid sulfur dioxide. These solvents, in the absence of water and alcohols, lower the reacting range below six carbons in the case of paraffins. Reference is also made to the use of selenourea and tellurourea, which are analogues of urea, as complexing agents.

A third new patent by Fetterly[42] has claims for improving the porosity of the filter cake. This is accomplished by recycling a part of the adduct-forming fraction to form a heavier cake of crystals when the mixture being treated is very lean in the adduct-forming fraction.

In cases where there is a prolonged induction period before the crystalline complex begins to form, Fetterly[43] indicates that this period can be appreciably reduced by maintaining the pH of the system below 9.5 through the addition of suitable acids, such as hydrochloric, sulfuric, acetic, formic and phosphoric acids. In addition to the shorter induction periods, the lower pH values also induce the formation of crystals which appear to have better filtration characteristics than those formed at a higher pH.

Melrose[44] suggests the addition of a water-soluble salt of a nitrite, chromate or iodate to suppress the emulsification tendency exhibited in the process.

Several additional patent applications have been submitted, and it is probable that some of these shall appear as patents in the near future.

REFERENCES

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Limited Water Supply Dictates Equipment Choice For Gasoline Plant

Ringwood natural gasoline plant at Ringwood, Okla., which was recently dedicated, employs certain equipment features to minimize net water consumption. It is operated by Warren Petroleum Corporation.

THE Ringwood gasoline plant, serving the Ringwood oil field in Major County, Oklahoma, was recently dedicated with special emphasis on its modern equipment features. The new plant is operated by Warren Petroleum Corporation.

The basic equipment installation includes facilities to gather 50 million standard cubic feet of natural gas, compress it from atmospheric pressure to 750 pounds pressure for processing to produce in excess of 80,000 gallons of liquid products and more than 40 million cubic feet of residue gas delivered to the Oklahoma Natural Gas Company's transmission pipe line network, all quantities being on a daily basis.

Compressor facilities consist of five 2500-horsepower angle-type gas engine driven units. Gas processing facilities necessary to produce 32,000 gallons of natural gasoline, 24,000 gallons of butane, and 24,000 gallons of propane daily include major equipment units for absorption, distillation, fractionation, dehydration, treating, storage and loading. The residue gas is delivered direct from the absorption unit through scrubbers and a dehydration unit to the transmission line.

Some of the equipment features include: a) extensive use of aerial coolers for engine lube oil and jacket water and for hydrocarbon condensing; b) recovery of inherently available energy from a high-pressure oil stream by use of a combination hydraulic power and pumping unit; c) frequent use of pneumatic control for flow and temperature through activation from remotely located transmitter units; and d) employing hydrocarbon vapors to strip the absorption oil instead of generating steam for this purpose.

Two water wells are located 3½ miles southwest of the plant and are produced by automatically operated electric motor driven deep well turbine type pumps directly to the plant through a 4-inch line.

The limited water supply and treating cost necessitated certain equipment features to minimize net water consumption. These include: a) elimination of a steam power plant by using gas engine and electric power b) use of aerial coolers for such services as gas engine jacket water and lube oil cooling and hydrocarbon condensing and c) use of direct-fired rich oil furnaces for plant process heat. These furnaces have a total capacity of 36 million Btu per hour.

Construction of the plant facilities was started in the 2nd quarter of 1951 and operation commenced in April, 1952.

The general process scheme is to absorb natural gasoline, butane and propane from the gas in the absorber where it is contacted with absorption oil. The light gas which is not absorbed leaves the top of the absorber and passes through a scrubber and a glycol or liquid type dehydration unit thence into the Oklahoma gas transmission system.

Rich oil containing the absorbed heavier fractions of the gas including natural gasoline, butane and propane is processed through successive steps of heat exchange, oil stabilization and distillation until these liquids have been separated from the absorption oil and collected as a mixture in the raw product surge tank. From this tank the total stream is passed through a dry desiccant-type dehydrator to remove water. This step is necessary to produce specification propane and is of some benefit in reducing corrosion in the fractionation equipment.

The dehydrated raw product mixture is fed successively to the deethanizer, depropanizer and debutanizer to produce propane, butane and natural gasoline fractions.

The product storage consists of 13 1000-barrel pressure tanks.

Stringent Specifications Met by Highly Refined Petroleum Oils

DR. G. CIBULA, Hamburg

Translated by Edwin J. Barth,
Petroleum Technologist

AMONG the many consumers of petroleum oils there are a large number who require a certain degree of purity for oil products utilized in the textile, metal, electrical and cosmetic industries, as well as in pharmacy and medicine. The petroleum refining industry produces oils possessing such requirements by heavily treating or refining certain fractions or distillates of petroleum. One of the characteristics of these oils is their very light color—in some cases for certain uses they are absolutely white; hence, the designation "white oils."

The selected fractions, often derived from dark-colored petroleums, consist of a mixture of hydrocarbons and quite an array of impurities. After more or less refining, these fractions will consist of a mixture of pure, or nearly pure, hydrocarbons. These then will consist of oils containing only carbon and hydrogen.

The chemical and physical properties of these oils are dependent in the main on:

1) Content of carbon atoms in the molecule,

2) Structure, or the combination of the carbon atoms one with another or with hydrogen.

As is well known, for instance, a low number of carbon atoms in the molecules of a hydrocarbon oil points to volatility and great or high fluidity —these oils being gasoline, low boiling distillates, etc. The medium or middle molecular weight hydrocarbons up into the viscous range are the stocks for lubricating oils, while hydrocarbons containing a high number of carbon atoms give rise to the high melting-point waxes, asphalts, and the like.

Oils containing the hydrocarbons about in the lubricating oil range are fairly high boiling materials. This is one of the physical properties related to the size of the hydrocarbon molecule. All petroleum oils are usually grouped as to their primary uses. Before refining, the crude-oil is first separated into various boiling-point fractions into primarily fuels, lubricating-oils, and asphaltic or waxy residues.

The various combinations of the carbon atoms within the hydrocarbon molecule (such as straight or branched chains, rings, etc.) determine primarily the differences in chemical properties, or better chemical inertness. The hydrocarbons are said to belong to such groups as the paraffins, naphthenes, aromatics, etc. Concerning chemical properties, the chemical reactivity or hydrocarbons toward active substances such as oxygen, acid and alkalies, is of prime consideration; those hydrocarbon groups most resistant to the action of these substances find an extended use over the less resistant or reactive oils.

In the case of gasoline and similar fuels the chemical properties have been somewhat more or less secondary to their more important physical properties. In the case of the lubricating oils under discussion chemical constitution is of prime importance.

During the distillation of crude oils some small portion of the hydrocarbon content usually undergoes a marked change—due usually to a slight degree of cracking; or even polymerization or condensation reactions may take place. These are, of course, undesirable reactions. Due at times to local overheating of the oil in the still, hydrogen atoms break off from the hydrocarbon chain, decreasing the atomic saturation, and the resistant character of the oil molecule. Even though the hydrocarbon groups are not equally resistant to chemical action, yet the materials formed by any cracking in the stills are very reactive to oxygen, acids and the like. Reactive molecules of this nature absorb or combine with active chemical elements (or the unsaturated groups may combine with one another, as in polymerization). The unsaturated or unbalanced structure of the molecule thus becomes more or less saturated.

Lubricants are exposed to reactive chemical agents during the lifetime of the oil, such as air (oxygen), metals (as in bearings) and eventually build up by-products of the reactions taking place. The influence of light, heat, dust, etc., tends to accelerate the breakdown. Any unsaturated material, resinous or colored material present readily converts to dark colored viscous by-products (sludge, tar, carbon, etc.).

The formation of organic acids takes place simultaneously with the above changes. Acid formation, with or without tar formation, is designated as "aging," and is the result of oxidation. The degree of aging limits the use of many oils for over-all application or for specific types of lubrication.

Besides the straight or pure hydrocarbon material in crude petroleums there are present also so-called impurities in varying percentages; the latter are hydrocarbons containing sulphur, nitrogen, oxygen, etc., as part of the molecule. These elements may also occur in compounds not regarded as hydrocarbons, such as the organic sulphides, nitrogen bases, etc. The so-called impurities find their way into the distillates during distillation of the crude oil. As to the reactivity of these groups, it can be said that they are generally about as reactive as the straight unsaturated hydrocarbons. The whole series of many reactive materials and hydrocarbons are termed "impurities."

THE HIGHLY-REFINED oils constitute a special branch of petroleum products. These oils, which find use in the textile, metal, electrical, cosmetic, and pharmaceutical industries, must meet very stringent specifications. Especially important is their resistance to deterioration by action with oxygen, acid, and alkalies. Herein discussed are the various types of "white oils," and the processes used in their manufacture.

This article originally appeared in "Erdol und Kohle," Vol. 3, August, 1950, Number 8.

Factors for Use

The application or use of a petroleum product is dependent on approximately three requirements:

1) It must possess the proper physical properties for the particular application, such as viscosity, flash-point, pour-point, etc.

2) It must show some special inherent property, which is most impor-

tant. These properties are hard to measure or define as conditions of application control the desirable feature of the oil. For instance, in the case of lubricants, the oil must possess some virtue to lubricate; in the case of cosmetic oils they must be non-irritating; and the white pharmaceutical oils must be "harmless" and edible.

3) The properties in (1) and (2) should be more or less permanent over a time period; the oil should age or deteriorate as little as possible.

Item (1) is covered by specifications set up for the desired application, and carried out by tests during manufacture.

Concerning items (2) and (3) all the requirements interlinking these items have not been, as yet, too comprehensively evaluated. Some co-ordination of properties with tests, and uses, however, is forthcoming. The difficulties are appreciated when it is recalled that petroleum products are complicated mixtures of many hydrocarbons and that manufacturing processes vary considerably as to the various desirable properties the oils should finally possess or retain; a small variation in content of certain hydrocarbon groups may, for instance, greatly affect aging.

It appears plausible that so-called aging or oil degradation is attributed to unsaturated hydrocarbons, and to sulphur, oxygen or nitrogen-containing type of compounds. It becomes necessary to remove these materials, which is, of course, the object of the refining process.

Varied Refining Methods

The refining methods are varied. In one method, perhaps the oldest one in use, sulphuric acid of various strengths is employed as the refining agent. This reagent attacks the "impurities" quite rapidly; they convert over to polymer-type viscous tarry material called "acid-tar" or sludge. The latter is insoluble in the remaining oil, and is removed by settling, etc. The remaining oil, called "acid-oil," is next neutralized with alkaline solution or immediately neutralized, bleached, etc., with high quality bleaching-clay. A lighter colored oil than the original is obtained in most cases.

The treated oil may be only partly color stable. The acid treatment before neutralization may be repeated many times until a satisfactory product is obtained. The distillate also may be initially treated with large quantities of fuming sulphuric acid until a final neutral oil is obtained showing the properties desired, such as absence of odor, color, taste, etc.

A colorless medicinal oil called "paraffinum liquidum" posseses no lubricant properties when applied to moving parts, as in bearings, etc. (Item 2.)

Removal of Impurities

As to Item (3), deterioration will be very low, the oil aging only slightly. The aging test, however, in this case is mild and not to be compared with the degradation of oils at high temperatures, as in the case of the industrial oils. It appears from recent work that some of the so-called impurities are of value in giving viscous oils the desired degree of lubricant value (industrial oils), but these compounds to a large degree are often responsible for rapid deterioration in use. In the case of industrial lubricants it is the problem of the refiner to remove "impurities," as necessary, and yet preserve any natural lubricity the oil may possess, consistent with the lowest degree of deterioration possible.

Various researches have shown that certain derivatives in the larger group of "impurities" furnish oiliness qualities without causing decided degradation or oxidation or tar-formation during use; others seem to be excellent inhibitors for oxidation itself but furnish no oiliness properties; a third group furnishes "lubricity" to some extent, but may have decided tendencies to cause the oil to oxidize or degrade during use.

The manufacturer must detemine the conditions of refining the oil. The manufacturing procedure is based on three factors:

1) Type or composition of the crude.

2) Changes, if any, in the composition of the distillates during distillation.

3) Particular uses of the end-product or finished oil.

The refined oils are classified into three groups based on quality requirements called for in their application:

1) Normally refined oils, such as motor oils. These are prepared by either solvent treatment or with low percentages of sulphuric acid.

2) Special industrial lubricating-oils, refined with higher percentages of acid (or less acid in each of the several dumps). Turbine and transformer oils belong to this group. Most commonly only selected crudes or special fractions are used, finishing up with an oil of properties definitely suited to their use or complying with the special requirements for such oils.

3) Highly refined oils prepared with large quantities of solvents, or fuming sulphuric acid in many dumps or portions.

We will discuss the third group of oils more fully. The intensive refining procedure here used results in a most pronounced reduction in color to the point where the oil is colorless or "white." The exact line of color requirements for these oils is not pronounced. At one time highly refined oils having a yellowish cast or slight color were termed "vaseline oils"; the totally colorless oils are called "white oils." This includes the whole group of heavily refined oils; this group is still known more or less as "paraffin oils." The latter designation is a poor one as these particular oils have no relation to vaseline or paraffin; the designation "white oils" is truly a better term for the colorless oils since most of the oils, outside of cosmetic or pharmaceutical oils, show traces of color, and are not absolutely white and not edible.

More recently the slightly tinted oils have been termed "technical white oils," and those absolutely colorless as "pharmaceutical oils." The term "paraffina liquida" is a term reserved for the white oil grades, suitable for medicinal uses only.

As to various grades among the pharmaceutical oils, use is made of the specific gravity and viscosity tests, grading them as light, medium and heavy. The first grade usually comprises oils of between 3-5° Engler at 20° C., and for the heavy type a viscosity of 7-12° Engler. A specific gravity specification is usually inserted to give an indication of the paraffinic or naphthenic origin of the oil. The paraffinic oils, usually such as the Pennsylvania oils, show a lower numerical specific gravity than do the naphthenic oils. The latter are heavier.

Weight or Volume Basis

Naphthenic hydrocarbons appear to be more resistant to oxidation than the paraffinic oils. The specific gravity, in addition gives some indication as to the degree of refining, within identical base or groups of oils; the so-called impurities show a heavier or higher specific gravity than the general run of paraffinic and naphthenic oils. The oils may be purchased on a weight or volume basis.

The refining procedure using sulphuric acid entails losses due to the large quantities of strong acid employed; fairly large quantities of acid are needed to exhaustively remove all coloring matter plus "impurities." It so happens that appreciable portions of valuable hydrocarbon material are also attacked by the acid and are converted into useless by-products, such as sludge, etc. One must therefore reckon with refining losses of 60 percent or more by this method of manufacture.

During this stringent refining a de-

crease in the specific gravity and a marked loss in viscosity takes place. It is therefore necessary to start out with a raw distillate considerably heavier than the grade or viscosity of the finished oil desired.

In the application of technical white oils used in the textile industry, or as instrument or watch oils, great stability is called for; this necessitates a highly refined oil, since oxidizing oils producing small quantities of oxidized products quickly contaminate the sensitive parts of these machines; simultaneous corrosion also takes place due to attack of the organic acids formed.

However, as already mentioned, lubricity or lubricant-value diminishes as the stability of an oil becomes better. In order to increase the lubricity of these very stable oils, small quantities of neutral and stable fatty-oils are at times added. Best quality neats-foot oil is often used for this purpose (compounded oils).

Saponifiable Yet Oily

Highly refined lubricants for the textile industry (knitting, weaving, spindles, etc.) occupy a special place in this category. Due to the spraying of oil from the bearings or spindles there is the ever present tendency to spot or stain the fabric; the stains must be washable. Compounded oils are again called for due to these reasons; they are to some degree saponifiable, and yet will possess good stability, and a good degree of oiliness.

Such oils are relatively expensive and if the viscosity desired is too low, they still show some tendency to spray off from fast rotating spindles. To offset the thinning or dilution effect of the fatty oil, various soaps are added as oil thickeners. Any stains that may be formed on the fabric by spraying of the oil are then easily washed out. The so-called "permanent oils" were thus developed. The water-soluble and saponifiable constituents aid in removing the lubricating oil from the fabric before final finishing of the yarn. Any impurities in the form of insoluble oxidation products would ordinarily leave spots and stains on the finished fabric after washing. Highly refined oils are called for as a base to produce compounded oils, especially for use on heavily bleached textile goods followed by sensitive dyeing processes. The matter of oil purity can be over-emphasized since staining is also caused many times by minute metallic particles and rust originating in the bearings. The best solution in this case is to redesign the bearings, as mentioned by E. H. Kadmer some years ago.

The textile industry also uses technical white oils, besides in lubrication, also in the form of oil emulsions to soften wool, cotton and silk yarns and to impart glossiness. Such oils are good wetting oils, and when used sparingly their purpose and object is to gather and attach the loose microscopic fibers back to the threads and thus produce a soft feel to the yarn.

Technical white oils are used in the leather industry as fattening oils (compounded for kid and as high-gloss oils for chrome leather, which is of high quality and light color), the object again being to give a softening effect to the material.

The metal-working industry employs technical white oils in the quench-hardening of small delicate parts, such as watch springs, screws of very small and exact dimensions; coke, carbon or formation of corrosive products during the process rule out any type of unstable or oxidizable oils.

In summarizing the various uses for these specialty oils, the recent development of non-sludging turbine should be mentioned. The objective to obtain non-sluding properties has led to processes for heavily treating various distillates, obtaining in most cases, turbine oils which are technical white oils.

Some type of polar hydrocarbon material, however, is needed to lend some degree of oiliness to these oils. Most of these hydrocarbon compounds give rise to instability; on the other hand, the impurities discussed here apparently show anti-oxidant properties and are inhibitors toward certain kinds of oxidation. Some of the inhibitors form protective substances, such as may be the case on metal surfaces, bearings, and so forth.

Protective substances present at times in the crude distillate to be treated are most often removed and lost during the treatment. By careful adjustment of the refining procedure good stability is obtained with most distillates; stability decreases as the solvent or acid treatment becomes more drastic. Modern turbine oils are therefore additive-containing oils, derived from the idea of adding neatsfoot oil to white oils, forming the compounded oils used in the textile industry. The modern turbine oils are therefore still the fairly heavily treated type of oil to obtain certain types of stability, and adding back or incorporating specially designed compounds to the oil to obtain some suitable type of stability requirement, not obtained by mere treating in the plant. This procedure produces stable oils under highly controlled conditions without relying on the presence or absence of so-called "natural inhibitors."

The picture is somewhat different in the case of the pharmaceutical and cosmetic white oils; highest stability and purity is called for, as is evident. The stability requirements are different from those of the industrial oils. The medicinal oils are not subjected to high temperatures, and of course seldom used in the presence of corrosive or reactive substances.

A drastic refining or purification procedure is called for to remove eventually the last traces of reactive impurities. The presence of the latter is usually detrimental when such oils are compounded with medicinal agents, perfumes, waxes, and the like. Most of the impurities that may be present in the oil are of an acid nature, either remaining in the oil from improper treatment or more often the result of newly formed oxidation products; materials of this type are irritants. One of the requirements for these white oils is that they must show no acidity. Careful manufacturing control nowadays eliminates the presence of free or mineral acids. Drastic treating conditions likewise remove potential oxidation accelerators.

The cosmetic oils, which are almost white, are suited for external use only. They are blended with a variety of substances, and are used in creams, ointments, pastes, etc.

Medicinal Oils

The pharmaceutical or medicinal oils, intended for internal use are the most drastically refined oils, passing various national pharmaceutical tests. They are used as laxative oils, and as solvents in obtaining of various plant extracts; a tasteless, odorless and non-fluorescent oil, having the appearance of water, is called for.

It is generally the practice to refine the more viscous petroleum fractions, as very low viscosity oils, such as spindle oil cuts, usually finished up with a characteristic "oily odor."

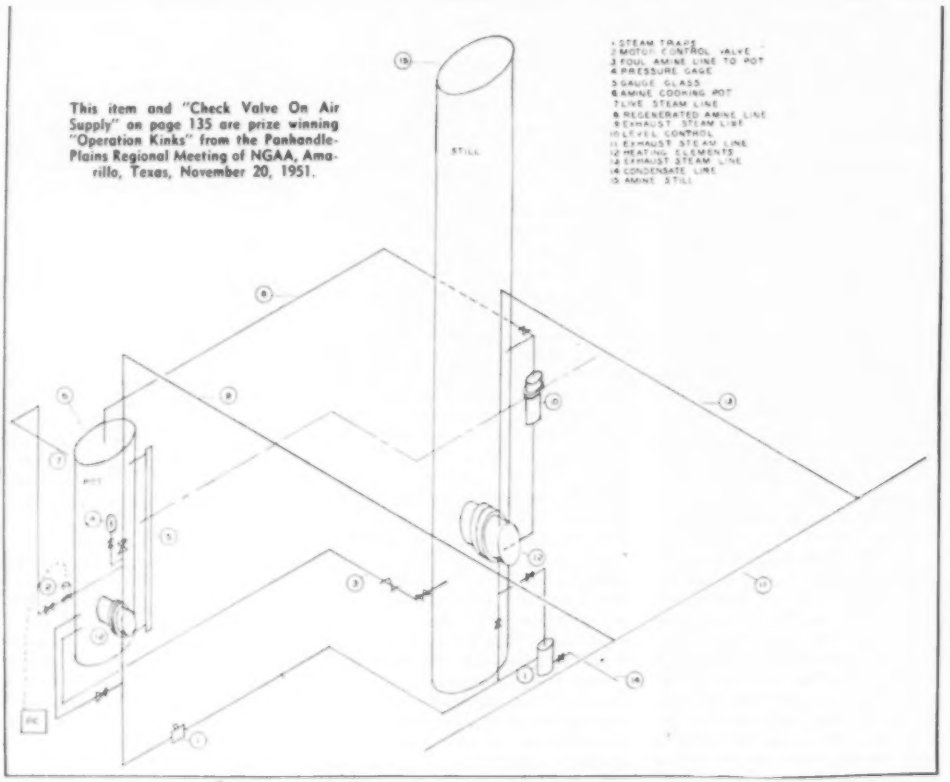
The finished white oils are the "paraffina liquida" used in pharmacy, though the term has no connection with the paraffin of commerce. Actually, whatever their original, these oils contain considerable naphthene hydrocarbons.

These oils, as stated, are used as laxatives, and are not absorbed in the human body. They find use also as sterilizers for medical instruments, and to some extent as anti-rust oils at ordinary temperatures.

Virtually all countries have detailed specifications and test-methods in their pharmacopeias to insure pure and edible white oils. Revisions to these specifications are made from time to time, usually only in the minor tests such as specific gravity, viscosity, and other properties.

MAINTENANCE And OPERATION How To Do It—

Amine Reclaimer



This item and "Check Valve On Air Supply" on page 135 are prize winning "Operation Kinks" from the Panhandle-Plains Regional Meeting of NGAA, Amarillo, Texas, November 20, 1951.

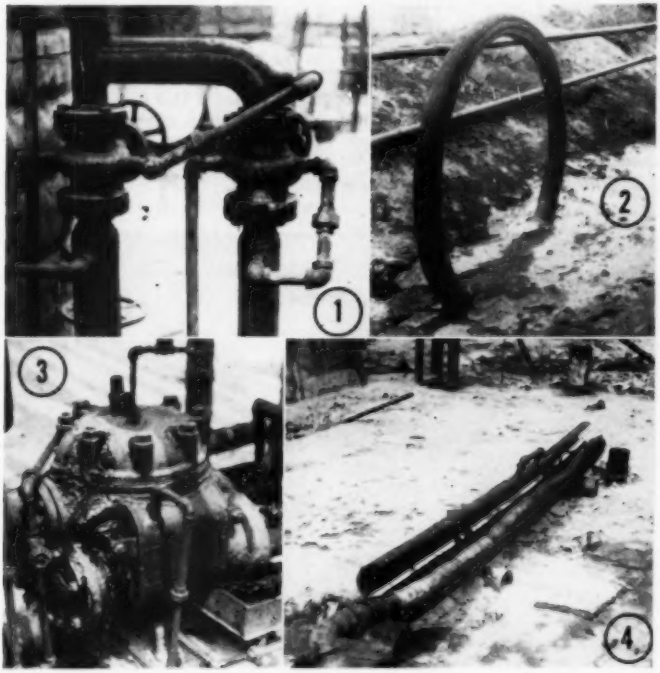
THE conventional method of cleaning amine solution is to periodically set a "pig" at the treater, operating this pig until the solution is clear. This pig requires numerous controls and a considerable amount of piping.

The reclaimer illustrated is permanent and is in continuous operation. The operation, requiring a minimum of attention, has only one control, which is not a necessity. The reclaimer is set so that its level is maintained by the treater still level controller. The feed comes from the still bottom through a check valve. The heating element receives exhaust steam downstream of the meter on the treater still line. This causes the reclaimer to operate at the same temperature as the still and prevents cracking of the amine.

When the reclaimer is full after approximately ten days of operation, the feed is cut off as well as the exhaust steam. Live steam is then used to concentrate the reclaimer solution. When the solution is concentrated, the steam condensate is used to restore the solution to the original levels. After a second concentration, the residual is dumped through a valve in the bottom of the reclaimer.

—George Zorns
Phillips Petroleum Company
Hobbs, New Mexico

Maintaining Asphalt In The Fluid State



ONE refiner, faced with maintaining asphalt in the fluid state through lines, valves and pumps, solved the problem without special equipment through the use of steam jackets and pads.

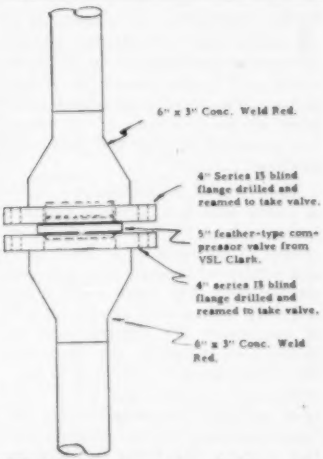
The most pressing problem was the congealing of asphalt in cast-steel gate valves. Loosening frozen valves with the aid of a dutchman resulted in excessive breakage of valve stems. The problem was finally solved by the use of a steam course as shown in Figure 1. The steam course is made by splitting a two-inch pipe nipple in half. These soles are forged to the contour of the valve body and then welded in place. By welding two 1-inch pipe collars at opposite ends of this jacket, steam was piped from the steam jacket on the adjacent line.

The expansion loop in an asphalt line presented a special problem since complete jacketing was out of the question. The use of a half sole welded to the outside rim has proved to be a satisfactory heating pad as shown in Figure 2. Particular attention must be given to the type of weld on this loop, as the weld must have the same coefficient of expansion as the loop.

With pumps used in intermittent service, asphalt congealed in the valve chambers, piston and packing to make the pump inoperative. The use of a torch to heat up the fluid end of the pump was used as an expedient measure, but the practice of playing an open flame on any kind of equipment is dangerous. As an alternative, the pump was flushed with hot solvent. The final solution was the use of a steam chest on each side of the pump as shown in Figure 3. The chest was fabricated from sheet metal and was shaped to the contour of the pump. The use of lugs to hold the chest against the pump aided the job of welding cast iron and steel. The use of this steam chest serves as an adequate heating pad for pump start-up even when the steam has been shut off previously.

Loading hose, employed to transfer hot asphalt into tank trucks, was also heated with a steam-jacketed scabbard as shown in Figure 4. By keeping the metallic hose cased in the scabbard, the residue of asphalt in the unit is fluid at all times; and loading can be begun as soon as the driver makes connections to the tank truck. The scabbard is made by splitting a convenient length of 6-inch pipe and welding scabs on the outside of both sections. Provisions were made for steam to enter and pass through both sides. Steam hose is used for the jumper, since the scabbard must be opened and closed several times daily.

Check Valve On Air Supply


6" x 3" Conc. Weld Red.
4" Series 15 blind flange drilled and reamed to take valve.
5" feather-type compressor valve from VSL Clark.
4" series 15 blind flange drilled and reamed to take valve.
6" x 3" Conc. Weld Red.

TO GIVE a positive check on air supply pressure, the valve shown in the sketch was fabricated for an instrument air compressor. Two 4-inch series 15 blind flanges were drilled and machined so as to take a 5-inch feather-type compressor valve. A 6-inch x 3-inch concentric weld reducer was welded to each flange and also to the piping.

—*Hugh Smith*
George Zorns
Phillips Petroleum Company
Hobbs, N. M.

Handling Barrels In Groups of Four

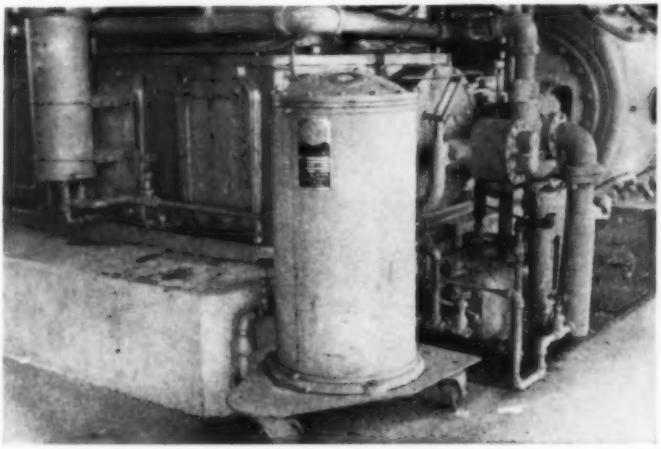
TO EXPEDITE the movement of drums used for shipping asphalt, one welder developed a set of lifters which will handle barrels in groups of four. The device is patterned somewhat on the principle of ice tongs, but expanded to suit the particular problem.

The frame of the apparatus is made of heavy steel bars, approximately 3 inches wide and a half-inch thick, arranged in the form of a Greek cross and reinforced between each arm with similar steel. The outer ends of the arms are drilled with an oblong hole to compensate for different sizes of drums when lifted by the apparatus. The lifting tongs are attached to these holes with clevises and pins, made from machine bolts so the clevises may be disconnected or locked tightly with lock washers. The frame in which the pair of tongs is retained is made of heavy metal plate in the form of a truncated pyramid, with chopped corners. The frame contains two identical plates with a ring at the apex welded to a ferrule, as a spacer, through which a machine bolt is inserted to lock it in place. At each corner of the frame, identical holes are drilled to support the arms of the tongs with welded ferrules and machine bolts. The space between the side plates and the ferrule is such that the arms are free to move up and down without binding and frequently are lubricated to prevent friction.

The outer ends of the tong arms are bent sharply at approximately 90 degrees, forming a finger about 2½ inches long. On the inside of the finger is a short piece of angle iron with the top angle trimmer to fit beneath the bead at the top of a common oil drum. These angle iron pads are bent slightly, to conform to the average size drum so the grip below the top bead will be secure and firm.

The dimensions of the cross are such that the oblong hole at the outer end will be within narrow limits, to place each of the four the same distance apart. When placing empty drums on a platform, they are always set in patterns of four. If filling on a circular track, the drums are placed in two rows, or multiples of two, so the pattern will always provide four drums set closely to each other.

The truck handling the apparatus is equipped with a telescoping boom which may be shortened or lengthened at will. The winch line of the truck passes over a sheave at the tip of the boom and ends at a loop, which is inserted in a clevis attached to a loop in the exact center of the cross. The truck may be backed up to a platform too high for a fork lift and may be adjusted to load railroad cars, or the boom can be passed into the open door of a box car when shipping drums by rail.



Dolly for Oil Purifier

WHERE a large and heavy oil purifier is used on compressors, the job of cleaning and replacing the inside element has been simplified by building a dolly for the instrument. This type purifier was built with a ring base containing three equidistant holes for mounting permanently on a pier or other solid foundation. The dolly was made by trimming a sheet of tank steel in a rough triangle, wider at the back than at the front, so three casters could be attached, thus eliminating as much overhang for the foundation as possible. The casters were mounted in the conventional manner, each being free to rotate in a full circle; and the purifier case set down on the steel plate and bolted in position. Oil lines were connected from the purifier to the circulating system of the crank-case of the compressor, and the unit remains in position until such time that reconditioning or cleaning may be required. At this time, the oil lines are broken out, and the purifier is wheeled to a convenient place on the floor, or even outside the building, where waste oil can be disposed of without making a mess on the clean concrete.

Maintenance and Operation Ideas Are Worth Money.
Send your HOW TO DO IT suggestions with photos or sketches to Editor, Petroleum Refiner, Box 2608, Houston, Texas.

Cit-Con Whips Lube Plant Instrumentation Problems

Automatic regulation of compressors used for pressure control; temperature-controller over-instrumentation solved

E. W. MIDLAM and J. D. DORSEY
Cit-Con Oil Corporation, Lake Charles, La.

INSTRUMENTATION of new plants is never easy and often the problems must be solved by trial and error. Cit-Con's lube plant at Lake Charles, La., was no exception but their instrument department rose to the challenge offered by four major problems.

As a background to the instrumentation problems, the oil processing facilities consist of twin vacuum units for preparing five base cuts. From these cuts five grades of high V.I. lube oil are produced by a blocked operation. The three lightest distillates are solvent refined in the Furfural unit, then MEK solvent dewaxed and contacted. The heaviest distillate and the short resid from the vacuum tower bottoms are solvent refined in the Duo-Sol unit, then MEK dewaxed and contacted. In addition to these lube oil operations the paraffin waxes from the three lightest distillates are finished to market specifications by blending, bauxite percolation, slabbing and packing. Throughout all these units there are nearly 800 instruments and some 450 diaphragm motor valves.

The first item to be discussed deals with the compressor control at the Duo-Sol unit. The problem was to design an instrumentation system for the automatic control of the compressors which regulate the pressure on the distillation units. These compressors maintain a constant pressure on seven towers operating at 70 pounds propane pressure. The towers are either distilling or stripping essentially single boiling point materials such as water and solvent from relatively non-volatile oils. The bottoms composition of these towers is very sensitive to pressure and temperature changes. A change in pressure of a few pounds can either stop distillation or cause extremely fast distillation with the resultant danger of "pukes." One circuit in this system includes a tube still reboiler. Changes in pressure here have a tremendous effect on the system. This is because the liquid holding capacity of the tube still is far greater than the tower the tube still is circulating. Here a reduction in pressure causes sudden evaporation in the tube still and a large quantity of liquid is displaced from the still into the tower. The tower bottom is on level control so the liquid pushed out of the still immediately flows out of the tower. The return of pressure to normal means that evaporation in the tube still will be suppressed and the tower level will go very low in order to refill the tube still. These points show the importance

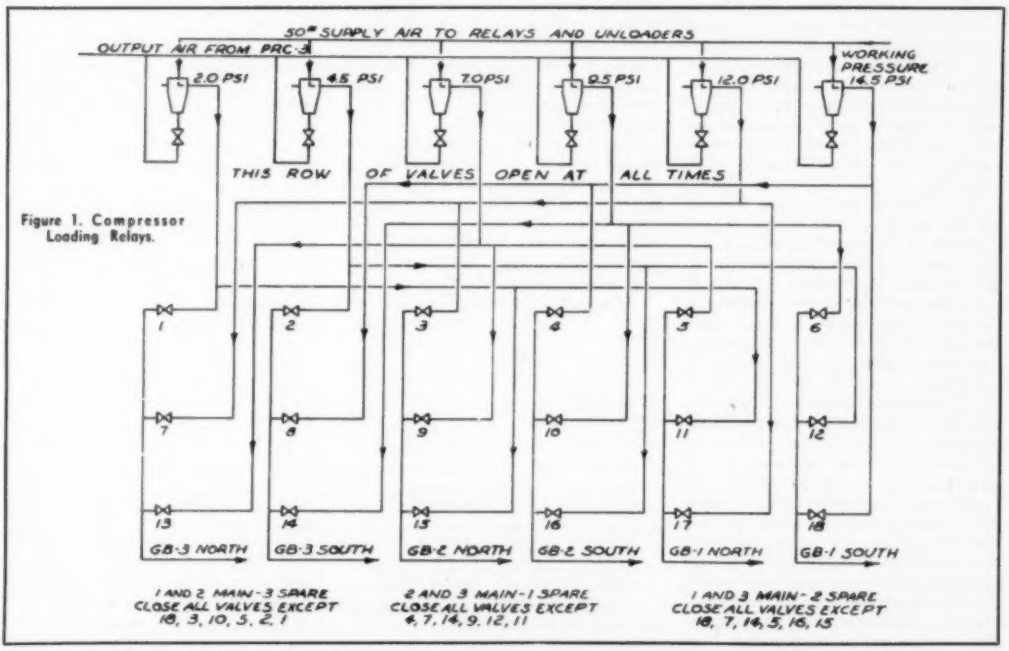


Figure 1. Compressor Loading Relays.

of good pressure control for this system.

Propane is continuously flashing into the 70-pound system from a 250-pound propane system. In addition a blow down from equipment in the 250-pound system is tied into the 70-pound system.

The three compressors handling the propane gas in the 70-pound system are constant speed, motor driven, single-stage reciprocating machines. The compressors are equipped with air operated diaphragm unloaders.

The system installed at Cit-Con to maintain a constant pressure on this 70-pound system is described below. See Figure 1.

The heart of the control is a master pressure control instrument which supplies the impulse to operate compressor unloaders, compressor start-stop controls and a shutoff valve on the blow down system. The compressor unloaders are air operated diaphragm types operating on 50-pound air. The air to the unloaders is supplied through snap action three-way relays which are set to act in a prescribed sequence as the output air from the master pressure control varies. The start-stop controls also fit into this sequence as does the shutoff valve for the blow down system. The steps in this operation can best be seen if conditions are assumed as follows: The compressors are lined up in the normal way with one compressor set for manual operation, which means it will be running at all times, and the other two compressors in automatic position ready to cut in and out as required.

It will also be assumed that pressure on the system is below the desired pressure of 70 pounds but rising. Under these conditions the manual compressor will be running completely unloaded and the other compressors are shut down. As the pressure rises the first set of unloaders of the running compressor will load, so that the compressor is half loaded. The second set of unloaders then loads so the compressor is running fully loaded. As the pressure rises further the blow down control valve starts to close so that pressure from an outside source will be reduced. The pressure still is rising so the second compressor starts fully unloaded. First one set of unloaders then the other load up and there are two compressors running fully loaded. At this point the blowdown control valve is completely closed, shutting off any outside source of propane. Continued rising pressure then causes the third compressor to start fully unloaded.

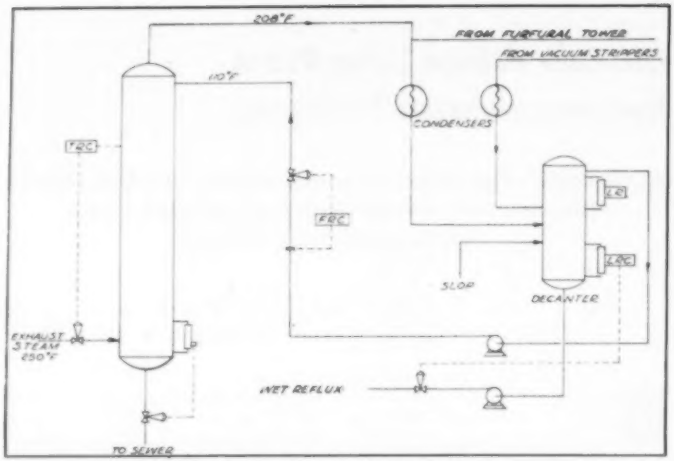


Figure 2. Water Removal System-Furfural Unit.

It will then load up in the manner described for the other compressors. In general, the three compressors fully loaded will take care of all conditions because they are sized so that two of them will handle the normal maximum design propane load. If a condition should arise where all three compressors do not handle the load and the pressure continues to rise, there is a simple pressure controller on the suction trap which will open a control valve to a flare line. Excess pressure will be bled off before safety valves begin to pop. This is an important consideration because if the tower safeties let go, valuable solvent vapor and propane will be lost.

Table 1 covers the operation of the system with the actual sequence of each operation in terms of controlled air pressure from the master pressure controller. This shows the close calibration necessary for the various operations. The same conditions hold here as were assumed earlier.

As a control system this works very well. The real complication comes when the system is installed so that any of the three compressors can be used on manual with either of the two remaining compressors being either first or second automatic. This had to be set up so the operators could make such a change depending on their choice or the mechanical condition of the compressors. Figure 1, a sketch of the actual instrumentation, shows how this was done by using a number system. It can be seen that if the operator opens all valves listed for one group and closes all those not listed, he knows he has a certain sequence of operation.

TABLE 1

Output Air Pressure Of Master Pressure Controller	Function
At 14.5 Pounds	1st set of unloaders on manual compressor load.
12.0 Pounds	2nd set of unloaders on manual compressor load.
12.0 Pounds	Blow down control vlave starts to close.
10.5 Pounds	2nd compressor starts unloaded.
9.5 Pounds	1st set of unloaders on 1st automatic compressor load.
7.0 Pounds	2nd set of unloaders on 1st automatic compressor load.
6.0 Pounds	Blow down control valve is fully closed.
5.5 Pounds	3rd compressor starts unloaded.
4.5 Pounds	1st set of unloaders on 2nd automatic compressor load.
2.0 Pounds	2nd set of unloaders on 2nd automatic compressor load.

The first design of the pilots used gave some trouble in this application. The pilots could be set accurately enough but if both set screws did not hit in a groove of the knurled knob, an uneven pressure on the large adjusting knob would cause the adjustment to be off as much as two pounds. This was particularly objectionable when it made an automatic compressor start partially loaded. The latest pilots have a lock nut arrangement on the adjusting knob and no trouble is now encountered with change of adjustment.

The next problem occurred at the furfural unit and involves a case of over-instrumentation which caused many unnecessary hours of hard work for both the operators and instrument men who tried to make this installation work. This case involves the water removal tower of the solvent recovery system. Final stripping of furfural from both raffinate and extract is done with steam. Therefore the condensate from these stripping towers contains both water and furfural. A primary separation of the furfural and water in the liquid state can be made by a decanter. The best separation which can be made in a decanter is about

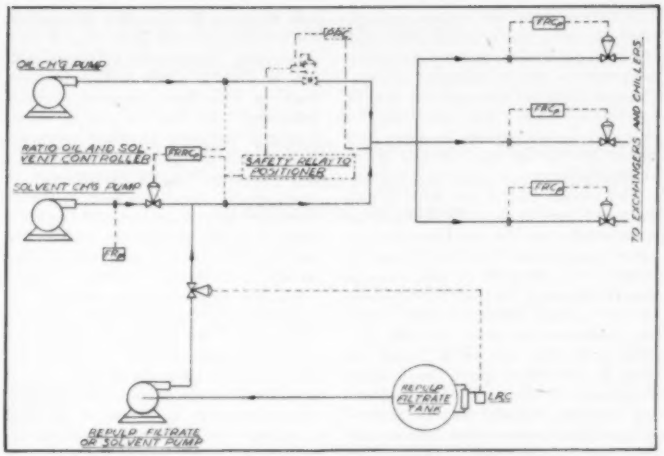


Figure 3. MEK-2 Oil and Solvent Charge Instrumentation.

80 percent furfural removal at 110° F., which temperature is about as low as can be expected with 92° F. cooling water. This means that 20 percent of the furfural coming into the decanter will remain in the water layer. It is the function of the water removal tower to recover the furfural which will not settle out of the water. This is done by a distillation process in which all the furfural and some water are distilled overhead. The boiling point of this mixture is lower than the boiling point of pure water. In this system the water layer from the decanter is pumped to the top tray of the water removal tower. Exhaust steam is introduced into the bottom of the tower to supply the heat to distill the water-furfural feed mixture. The general arrangement and instrumentation of this tower are shown in Figure 2.

This looks like a perfectly feasible control setup for such a system. With steam as the heating medium the temperature controller regulating the steam should assure sufficient heat to the tower. If the temperature should fall more steam would be added and vice versa. In most systems this would be true. In the furfural-water system under discussion the temperature controller cannot operate in a straight forward manner. The boiling point of furfural-water mixtures with compositions varying over the wide range of from about 93 percent furfural—7 percent water to 5 percent furfural—95 percent water all have a constant boiling point of about 208° F. at atmospheric pressure. Even with 100 percent steam there would be a temperature change of only 4° F. A big change would occur only if the vapor composition became greater than 93 percent furfural, which would not be possible with the use of open steam. Soon after operation was started it was noticed that no matter how much steam was put in the bottom of the tower, the temperature recorded on the TRC did not change. As usually happens, after many hours of trying to make the installed instrumentation work, a review of the process factors was made. This study revealed that the furfural-water system is a constant boiling mixture in the concentration range used. Therefore the temperature remains constant and a TRC could not possibly work.

The TRC was finally removed and the steam is now set by hand, from experience, at a point where it is known that enough heat will be added to distill all the furfural from the water layer of the decanter. A sniff of the water from the bottom of the tower shows when enough steam is being added. If the steam is set in excess of that needed for distillation of the furfural, the tower performs its function without further attention. The only precaution necessary is to see that the excess steam used does not overload the condensing system or decanter.

This case is presented as one of those which often can be repeated in successive designs. It also illustrates clearly how a good understanding of processing can be most useful to an instrument engineer. This does not mean an instrument man must be a process engineer, but he should try to dig into those fundamental concepts which are involved in the system that is being instrumented.

The next two cases which have some unusual features occurred at the MEK dewaxing units. The first of these deals with the instrumentation of the control on the waxy charge to the dewaxing unit, blending of solvent with this waxy oil, and distribution of the resultant charge mix into three parallel streams through double pipe exchangers and chillers. Unsatisfactory operation forced revision of the original system.

The original system as installed was quite conventional. It consisted of flow controls on each of the three charge mix streams to the exchangers and chillers. The waxy charge was not controlled directly but was the primary flow of a ratio controller which controlled a secondary solvent flow from a solvent receiver. This stream of solvent was not enough to supply the full quantity needed so an auxiliary supply of solvent was required. This came from another source under control of a liquid level on another receiver. The original control system is represented by the solid lines shown in Figure 3. On paper this looks like a perfectly operable set up. There were two things, however, which called for changing the instrumentation.

In the first place this system provided no protection against filling the chilling system with straight waxy oil and thus plugging it. This would result in a considerable loss in production. The situation arises if a solvent pump is lost for any reason. If this happens, the controlling flow meters on the three split streams do not recognize that solvent flow has been reduced; therefore they try to maintain the same flow as before. With the solvent flow reduced the waxy oil flow tries to meet the demand. The other solvent flow may also try to come up but will be insufficient and soon the pump will lose suction or the liquid level will shut off the flow, depending on which pump has been lost. It is obvious that this is an intolerable situation, for no matter how good the operators are, it is certain to happen sooner or later. As a corrollary to the above problem, another condition existed in our plant which could happen in any similar setup. The waxy oil charge pump had head characteristics which allowed it to put up so high a head at some plant capacities that the solvent pumps could not pump against it. This condition again led to exactly the same plugging of the chilling system with waxy oil as was described before. Perhaps the heads on the solvent and waxy charge pumps could be better balanced but it is easy to see that such balancing of heads with centrifugal pumps would be next

to impossible to cover all capacity ranges.

Both problems were put up to our instrument department and they recommended the instrumentation system shown dotted in Figure 3. These instruments are a pressure controller, actuated by a pressure tap on the combined charge mix line to the chiller flow controllers, controlling a valve in the waxy oil line, and an air relay from the transmitter air of the solvent flow of the ratio controller. This relay supplies air to the positioner on the valve installed in the waxy oil line. Here is how this system would react to some operating conditions. Consider again that a solvent pump is lost. This time either of two things happen, both of which will shut off the waxy oil so it does not plug the chillers. If the transmitter air of the solvent flow goes below the relay set point, the relay will shut off the waxy oil control valve by cutting off the supply air. If the solvent flow is reduced but not low enough to work the relay, the low dilution waxy oil mixture when chilled will raise the pressure in the chillers and the pressure controller will start reducing the amount of waxy oil being charged. Thus the new instruments furnish protection if a solvent pump is lost.

What do these instruments do for the condition of high head on the waxy oil pump? It is easy to see that the pressure controller can be set at a point where the valve controlled by the pressure controller throttles the waxy oil stream so the solvent pumps can function as desired without having to buck the extremely high head of the waxy oil pump.

With this setup the system can operate just as it was planned originally but with protection against operating interruptions due to plugged chillers. Changes in plant throughputs can be controlled easily and smoothly by changing the settings on the three flow controllers on the split streams going to the chillers.

The second case at the MEK plants discussed here deals with the main instrumentation of the refrigeration propane compressors which are centrally located and designed to take care of the refrigeration for both MEK plants. In this system there are three 1165-ton compressors. One provides for MEK-1, another for MEK-2, and the other is a common spare. One normal compressor is driven by non-condensing turbines which take 600-pound steam directly from the boilers and discharge into the 200-pound refinery system. From there it is used for heating and prime movers throughout the rest of the plant. The other normal compressor is driven by a condensing turbine and the spare compressor has a non-condensing turbine drive.

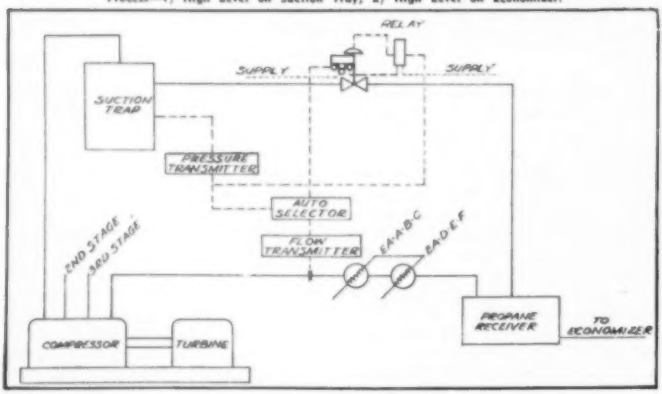
For steady operation, it is essential that the operating compressors maintain as constant a suction pressure as possible. The compressors operate at constant speed because with centrifugal compressors, especially of this size, it would be impractical to attempt capacity control by changing the speed of the compressor. This means that some other means must be found to maintain a steady suction pressure. The MEK system does not have rapid or frequent changes in refrigeration requirements, even though filters are regularly being taken off for washing. The surge tanks provided on the filter feed and filtrate which are used in exchangers ahead of the propane chillers take care of such changes in a satisfactory manner. The refrigeration load that does change is on the solvent coolers for the cold wash solvent used in washing the cake. This changes each time a filter is taken off the line for washing. This load, however, is small compared with the total refrigeration load and therefore its effect is small.

With this background of the system it is obvious that the easiest way to maintain a steady suction pressure would be to by-pass some of the compressor discharge directly back to the suction. This is what was done on the installation. On the surface it would seem that such a by-pass control operated by a pressure controller would take care of the full requirements for such a system. Where a centrifugal compressor is used, the by-pass control is not the whole answer. This is due to a characteristic of the centrifugal compressor and not the system itself. It is well known that if the flow to a centrifugal compressor is below some critical point, the compressor will develop a puffing action which can become quite violent. The machine will shake and lines will bounce around much like steam lines that have a water hammer. Since this is a flow problem, it is necessary to augment the compressor control system with a flow controller to prevent the flow from the compressor from falling below the critical point and causing "puffing."

The way instrumentation of the dual pressure and flow controls was applied in this installation is illustrated in Figure 4. Both the pressure controller and the flow controller are tied into an automatic selector. As long as the flow from the compressor is above the set minimum, the pressure controller will have full control to function as a by-pass controller. If it should happen that the flow should fall below a selected minimum the flow controller will take over regardless of the pressure condition. This is to make sure that the compressor does not develop a dangerous surge due to low flow. If under these conditions the pressure goes up in the suction trap something else must be done to adjust the load to the compressor that is affecting the pressure.

The selector control air is connected to the control valve through a relay. The function of the relay is to take the control away from the selector should the suction trap pressure reach 15 pounds. In such a case the by-pass valve will be closed by the relay. This is to protect the over pressuring of the suction trap and consequent overloading of the compressors by high-suction pressure.

Figure 4. Shutdown on Compressor 1) Shaft Seal; 2) High Discharge Pressure; 3) High Level in Oil Sumps; 4) Low Oil Pressure. Shutdown on Turbine—1) Overspeed trip; 2) Low Oil Pressure. Shutdown on Process—1) High Level on Suction Tray; 2) High Level on Economizer.



ACKNOWLEDGMENT

Original presentation under the title "Lube Oil Processing and Instrumentation Problems" was before the Symposium for the Process Industries, held at College Station, Texas June 3, 1952.

Have You Tried Aluminum In Your Refinery?

Design engineers giving aluminum consideration because of its unusual properties; use shows substantial increase

ELLIS D. VERINK, JR.
Aluminum Company of America, New Kinsington, Pa.

ALUMINUM, the young giant of the metals field, is assuming increasing importance as a construction material. Engineering designers must now give it careful consideration because of its unusual properties which insure its successful application in many fields.

During the past decade, the use of aluminum by the petroleum industry has increased substantially. Resistance to sulfur bearing gases, carbon dioxide, refinery atmospheres, sea coast environments, and cooling waters, coupled with an increasing cost advantage trend, has accounted in a large measure for this expansion in the use of aluminum alloys. Outstanding qualities include light weight, excellent resistance to corrosion, and good strength. Aluminum instrument tubing is enjoying wide usage. Because of the trend toward petrochemicals, many of the problems now being faced by petroleum refiners are the same as those which previously have been experienced by the chemical industry. Table 1 lists chemicals which have been handled and processed in aluminum equipment and represents avenues of future investigation of the application of aluminum alloys by petroleum refiners.

Tankage and Equipment

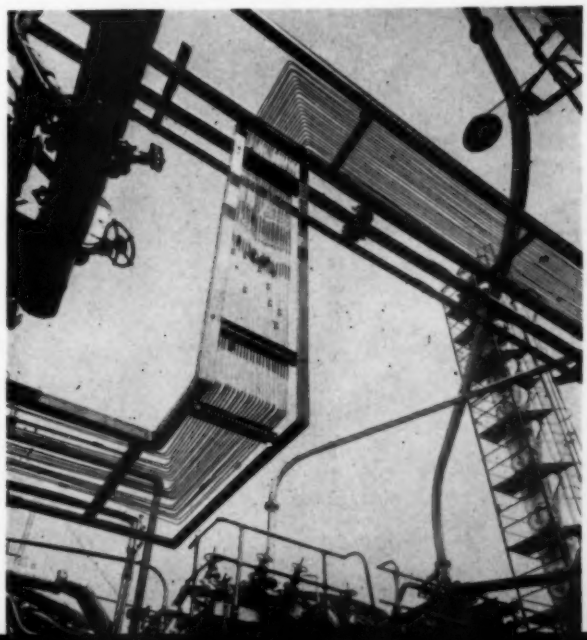
Aluminum storage tank roofs for sour crude oils have been in service for more than 20 years in locations where steel roofs failed in less than five years. At present, there are over 100 aluminum tank roofs in service. The ninth edition of American Petroleum Institute Standard 12C Appendix D contains information on the design and fabrication of aluminum roofs. Aluminum heat exchanger tubes have been used for more than 18 years handling sour gasoline stocks. Aluminum bubble caps have given service lives of 10 to 15 years in debutanizer columns handling gasoline distillate from West Texas sour crudes at temperatures from 200° to 425° F. Similar service has been realized from aluminum bubble caps in cracking unit fractionating columns for sour crude gas oils at temperatures ranging from 400° to 625° F. One major refiner uses aluminum bubble caps throughout one of its refineries for both sweet and sour stocks except where caustic or strong mineral acids are encountered. Tests prove that aluminum is as inert as glass to refined products, such as lubricating oils. This is important where it is desirable to avoid oxidation and sludging of refined products. Although both cast and wrought aluminum alloys have been used for this service, it is conceivable that the wrought alloy caps may have several advantages over the cast caps since they should have less tendency to "coke-up," are lighter, and are more ductile.

An acute sulfur and sulfuric acid shortage has led oil refiners to convert hydrogen sulfide removed from petroleum products into elemental sulfur or sulfuric acid. Aluminum forms and piping for molten sulfur are only some of the many uses of this metal in the production and handling of elemental sulfur. Because of their exceptional resistance to sulfur fumes and gaseous compounds of sulfur, aluminum alloys are also used for building materials and structural parts for plants in sulfur producing areas and in regions where the atmosphere is contaminated with sulfur or sulfur bearing compounds.

Petrochemicals

The use of aluminum is growing in the rapidly expanding petrochemicals industry. Thirty-six aluminum tank cars are in service transporting synthetic glycerine. Fleets of aluminum alloy tank cars also carry ammonium nitrate solutions, acrylonitrile, acetic acid, formaldehyde, etc. The long and successful service of aluminum with fatty acids, aldehydes, ketones, etc., is a matter of record. Aluminum resists corrosive action by these substances and does not cause discoloration or breakdown of the products

Aluminum Instrument Tubing Installation.



handled. Both of the large tonnage oxygen plants recently built for use in connection with Fischer-Tropsch synthesis plants have been built almost entirely of aluminum. Similar plants are in the construction stage. The selection of aluminum was based on low cost compared to competitive materials, desirable physical properties, corrosion resistance, and ease of fabrication. It is well known that the tensile and yield strengths of many materials increase as temperatures drop. In addition, aluminum alloys also increase markedly in elongation under these conditions. For example, aluminum alloys remain ductile at least down to the temperature of boiling liquid hydrogen (—423° F.).

Heat Exchangers

Because aluminum is resistant to hydrogen sulfide, ammonia, carbon dioxide, hydrocarbons, and cooling waters, aluminum heat exchanger tubes have proved ideal for catalytic cracking overhead condensers, as well as compressor intercoolers and aftercoolers. In one refinery, aluminum tubes are used in a heat exchanger handling the separated water phase from catalytic cracking in which ammonia and hydrogen sulfide are present in considerable amounts. Ammonia corrosion of copper base alloy tubes is becoming increasingly bothersome and has led to the use of aluminum tubes in a number of instances.

The catalytic polymerization and coking of furfural are familiar problems when using copper base alloy tubes for furfural refining. Because aluminum does not cause sludging of oils or furfural, aluminum tubes for lube oil and furfural coolers are widely accepted. Based on more than two years service, one refiner has reported savings up to $1000 per year in the maintenance of a single heat exchanger bundle by using aluminum tubes to handle furfural and furfural raffinates in a lube oil plant.

Aluminum heat exchanger tubes are being used in the production of gasoline from natural gas. Natural gas compressor intercoolers and aftercoolers have been tubed with aluminum and have shown successful continuous operation for more than three years. Depropanizer and debutanizer overhead condensers with aluminum alloy tubes also are proving very successful. Lean oil-rich oil heat exchangers having aluminum tube bundles are being substituted for steel, both because of their lower initial cost and because of excellent resistance to hydrogen sulfide contamination. The temperature of operation of lean oil-rich oil coolers is about 475° F. Despite this, a number of these units have been operating satisfactorily with aluminum tubes rolled directly into steel tube sheets. Generally, the use of aluminum tube sheets would be recommended where temperatures above 250° F. are encountered. This is done to eliminate possible loosening of the tubes from differential thermal expansion when the temperature fluctuates widely.

The percentage of sulfur-laden (sour) crudes and products to be handled is increasing. Because of their special resistance to these corrosives, aluminum tubes have been used successfully in the desulfurization of gaseous and liquid hydrocarbons. Diethanolamine and various glycol amine solutions are common absorbents used in desulfurization. Gas coolers used in conjunction with amine strippers have been tubed with aluminum because of its excellent resistance to corrosion by hydrogen sulfide.

The success of aluminum tubes in many oil refineries, gasoline plants and chemical installations has been primarily the result of the outstanding performance of aluminum clad tubes with fresh, salt and brackish cooling waters. No failures attributable to the cooling water (either fresh or salt water) have yet been observed where this type of heat exchanger tube has been employed, either in service in-

Heat Exchangers Utilizing Aluminum Alloy Tubes.

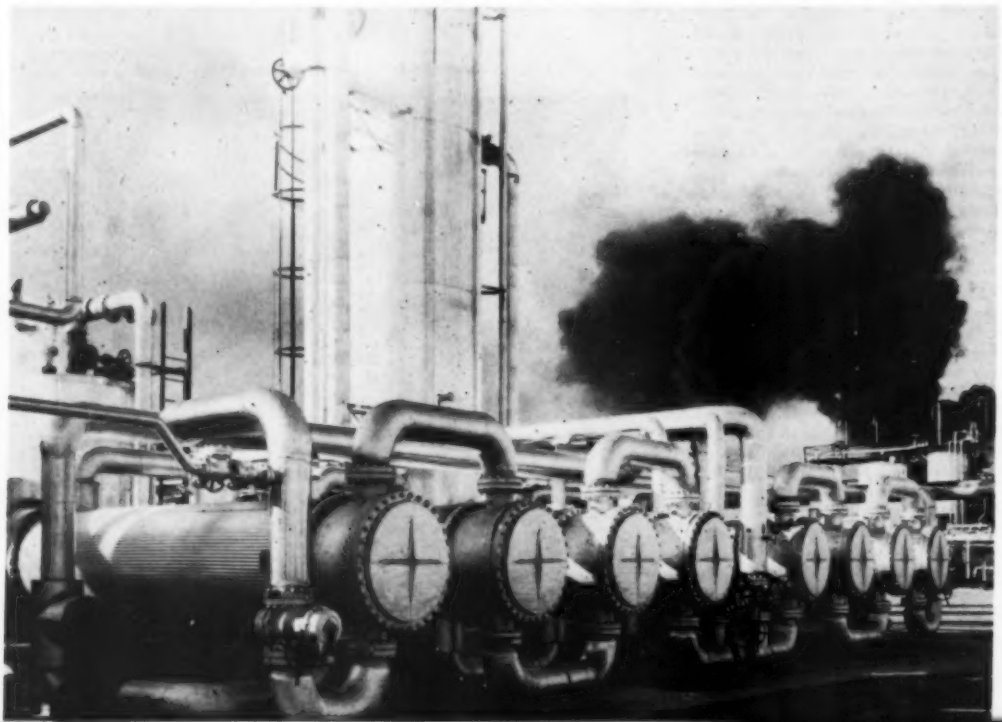


TABLE 1

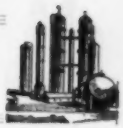
Related Aluminum Applications in The Chemical and Petrochemical Industries

Aluminum alloys have been used successfully in the processing and handling of the following commodities:

- Acetaldehyde
- Acetanilide
- Acetic Acid
- Acetic Anhydride
- Acetone
- Acrylic Acid, Glacial
- Acrylonitrile
- Aerosol Propellants
- Alcohols—methyl, ethyl, propyl and higher
- Ammonia Gas and Solutions
- Ammonium Nitrate and Ammoniated Ammonium Nitrate
- Amyl Mercaptan
- Benzaldehyde and Benzyl Alcohol
- Benzene
- Butyric Acid and Anhydride
- Carbon Dioxide Gas and Solutions
- Creosote
- Diethanolamine
- Essential Oils, Edible Oils, Vegetable Oils
- Explosives
- Fats, all types
- Fatty Acids—oleic, palmitic, stearic, etc.
- Formaldehyde
- Gases as Butane, Propane, etc.
- Glycerine
- Glycols—ethylene, propylene
- Hexane
- Hydrogen Peroxide
- Latex and Ammoniated Latex Solutions
- Methyl Ethyl Ketone
- Mineral Spirits
- Monoethanolamine
- Naphthalene
- Naphtha, Solvent
- Naval Stores—rosins, turpentine
- Nitric Acid, concentrated
- Nitroparaffins, crude and refined
- Orthodichlorobenzene
- Oxygen, Nitrogen and Liquid Air
- Paraffin
- Phenol
- Resins, synthetic
- Sulfur
- Tar and Tar Products
- Thinners, Paint
- Toluene
- Trichlorobenzene
- Waxes—petroleum, tar
- Water—distilled, fresh, brackish, sea

stallations or in experimental units. In the case of fresh water, one installation has been in service 17 years, while in salt water nearly four years have elapsed since installation. Installations on the Texas Gulf, and Atlantic coasts, where heavy industrial contamination exists, bear testimony to the excellent resistance of the aluminum clad alloy tube to these waters. Although clad tubes are generally recommended in preference to non-clad tubes, especially when there is no service experience or where complete analysis of the water being used is lacking, non-clad alloy tubes are being used with cooling waters where it has been determined that the waters being handled are not corrosive to it. When non-clad tubes are used, it must be established that the cooling water is free of even traces of compounds of metals such as copper, lead, tin, etc. Aluminum alloy tube sheets are generally recommended for use with aluminum tubes. With cooling waters having a chloride content less than approximately 50 ppm, aluminum tubes usually are successfully used with steel tube sheets. If subsequent inspection reveals galvanic corrosion, zinc bolted or sprayed on the water side face of the tube sheet can effectively reduce galvanic attack.

The excellent resistance of aluminum to atmospheric exposure has led to its increased use in windows, stairways, railings, tread plate, spandrels, roofing, siding, nails, paint, etc. Excellent appearance is obtained with a minimum of maintenance when aluminum alloys are used. A relatively recent development has been the use of aluminum sheet to weatherproof thermal insulation. Aluminum sheet normally is applied around a moisture barrier to prevent any possible corrosion which might occur should moist insulation contact the aluminum sheet. Another recent development has been the substitution of aluminum instrument tubing for copper. Aluminum instrument tube usually can be substituted size for size. Tube coils are available up to 1000 feet in length.



The non-sparking characteristics of aluminum and its light weight are advantageous in material-handling equipment. One large oil company has made considerable use of aluminum drum skids, dock plates, etc.

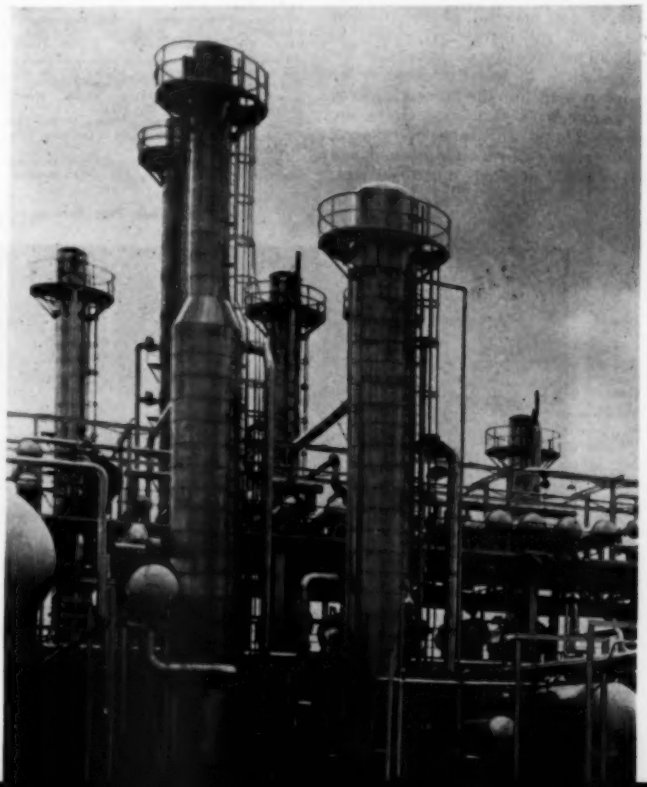
Aluminum cable, conduit, connection boxes, lighting fixtures, etc., are being used because of freedom from maintenance and long life in coastal, industrial and refinery atmospheres.

The design of equipment for use by petroleum refiners is governed by a number of regulatory bodies. Aluminum enjoys recognition at least partially by all the principal groups.

The 1949 edition of the Standards of the Tubular Exchangers Manufacturers Association (TEMA) includes standards for the construction of aluminum heat exchangers. Aluminum heat exchanger tubes are covered by ASTM specification B-234-48T.

The ninth edition of API Standard

Aluminum Sheet on Towers, Heat Exchangers and Pipe Lines for Weatherproofing.



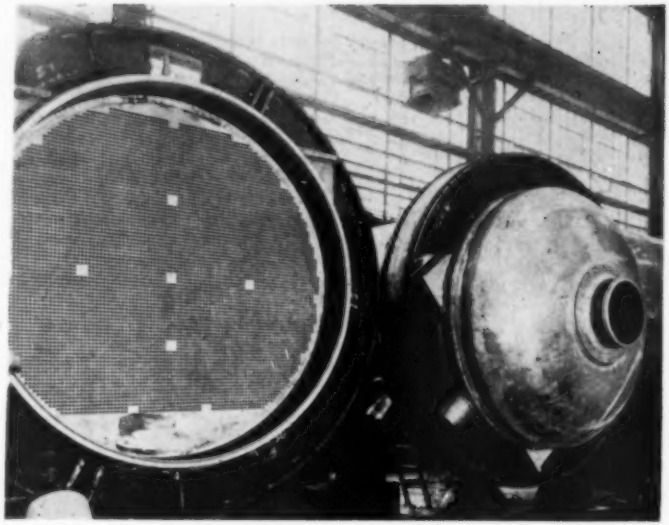
12C covers aluminum crude oil storage tank roofs and top rings in Appendix D.

The American Society of Mechanical Engineers (ASME) Code for Unfired Pressure Vessels recognizes alloys 3S and 4S under code cases 994 (reopened) and 1114, respectively. It usually is possible to obtain insurance for aluminum pressure vessels even when not specifically covered by ASME code cases where design and construction have been in accordance with the "intent" of the code.

Precautions

In common with other materials of construction, such as copper base alloys, aluminum alloys are susceptible to severe attack in the presence of mercury compounds or metallic mercury. Whereas copper base products are susceptible to stress corrosion cracking in the presence of these chemicals, aluminum alloys are susceptible to severe pitting attack and possible perforation. From contacts with industry, it is felt that the insidious effects of mercury contamination are not fully appreciated by design and operating engineers. It would be excellent engineering practice, regardless of the material of construction employed, for petroleum refiners to take all possible precautions against the introduction of metallic murcury or mercury salts into the process streams.

Inasmuch as aluminum alloys are susceptible to corrosion by mineral acids, such as hydrochloric acid and alkali metal or alkaline earth hydroxide solutions, special precautions should be taken to prevent the contamination of process streams by these materials.



Large All-Aluminum Heat Exchangers.

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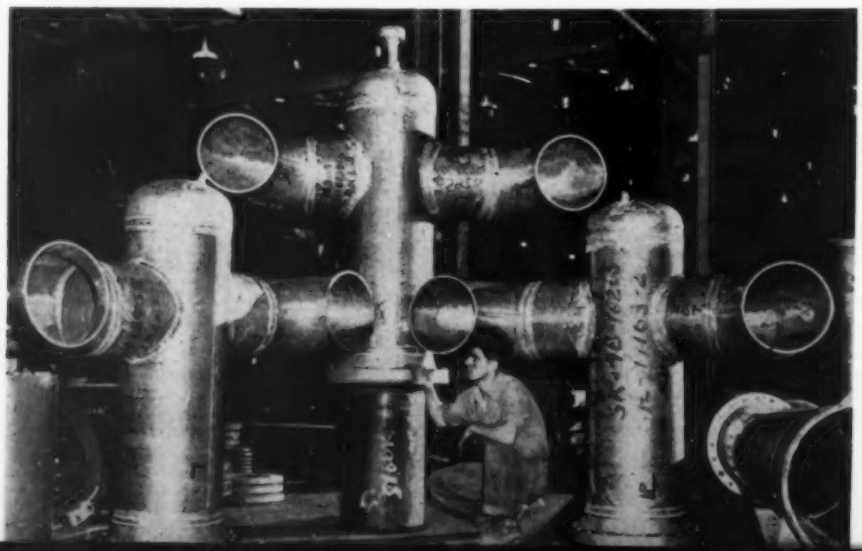
Welded Aluminum Pipe Fittings.



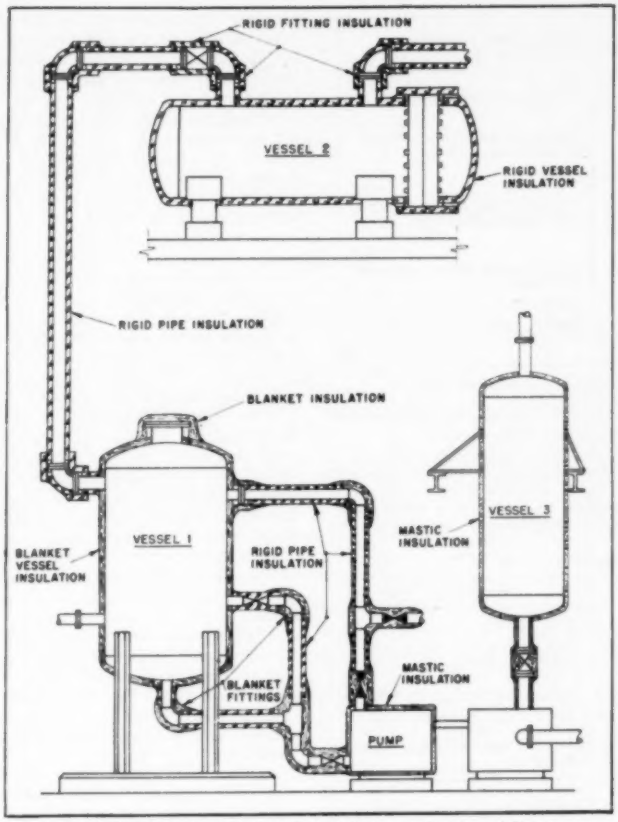


Figure 1B. Schematic Details of Typical Equipment, Pumps, and Piping.

Thermal Insulation for Industrial Requirements

Part V. Specification and Application of the Atmospheric Temperature Range Insulation

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South Charleston, W. Va.

THE atmospheric operating temperature range for thermal insulating materials is 32° and 212° F. At first thought only a simple application of insulation would seem to be required because of the small difference between the operating temperature and the atmospheric or surrounding air temperature. However, this is not the case. The moisture in the atmosphere causes a vapor pressure problem which is more difficult to handle than the thermal problem.

Where the operating temperature is greater than the surrounding air temperature, the vapor pressure is outward from the pipe or equipment surface, so a vapor barrier is not needed on the outer surface. Where the operating temperature is lower than the surrounding air temperature, the vapor pressure is toward the lower temperature surface of the pipe or equipment. A vapor barrier should then be provided on the outer surface of the insulation to prevent moisture, in the vapor stage, entering the insulation. Operating temperatures which fluctuate or which may be above or below surrounding air temperatures, depending on its level, present the relatively difficult problem of providing a vapor barrier to prevent the insulation from becoming wet without trapping moisture within itself.

After the requirements of an installation have been evaluated and selection of materials made accordingly, specifications should be prepared for obtaining the correct materials and for their proper application.

Depending upon operating and atmospheric conditions and methods of application, almost all insulations (except the upper elevated temperature insulations) may be used in this operating temperature range. Table A contains a list of insulating materials which are generally suited for the atmospheric temperature range.

TABLE A

MATERIAL	Approx. Upper Temp. Limit
Mineral Wool molded with asphalt binder	150
Felted cattle hair	250
Vegetable cork	250
Asphaltic filled cements	300
Layers of corrugated sheet asbestos	300
Glass fibers molded with binder	600
Laminated asbestos felts	700
Processed amosite asbestos fibers	750
Glass wool fiber cement	800
Cellular glass	800
Felted glass fibers	1000
Mineral wool molded with binder	1200
Calcium silicate	1200
Mineral wool fiber cement	1200
Felted mineral wool	1200

Other insulations may be added to this list. The list should not be interpreted to indicate that any one of these materials is the best in all cases. Each material has certain applications where it will be superior to others and that is where it should be used.

Specifications

Equipment specifications should name and describe the insulation (or insulations) to be used. Included

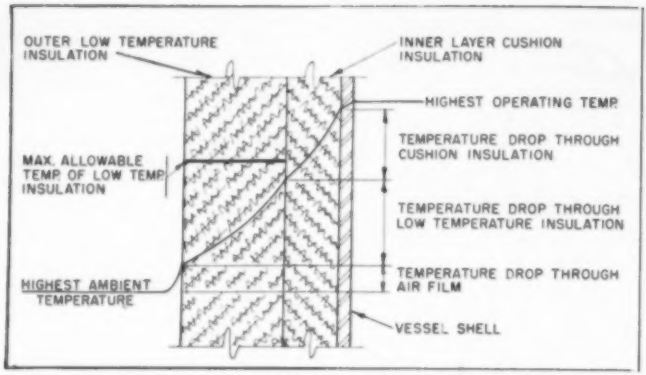

OUTER LOW TEMPERATURE INSULATION
INNER LAYER CUSHION INSULATION
HIGHEST OPERATING TEMP.
TEMPERATURE DROP THROUGH CUSHION INSULATION
MAX. ALLOWABLE TEMP. OF LOW TEMP. INSULATION
TEMPERATURE DROP THROUGH LOW TEMPERATURE INSULATION
TEMPERATURE DROP THROUGH AIR FILM
HIGHEST AMBIENT TEMPERATURE
VESSEL SHELL

Figure 2. Schematic Diagram of Temperature Drop In Application Type (3).

therein should be a list of the physical, chemical, thermal, moisture and electrical properties required, and any tests needed to verify them. (It is well to note the forms and sizes of the materials to be furnished and what tolerances in these sizes are permissible.) Any insulating cements or secondary insulating materials should be specified. Accessories used for securing, finishing, and coating should be listed and described in order to obtain the proper materials throughout.

Application of the materials needed in this temperature range is divided into four methods, depending upon operating conditions and the materials used. These methods are:

Method 1—Installations where operating temperature is above surrounding air temperature.

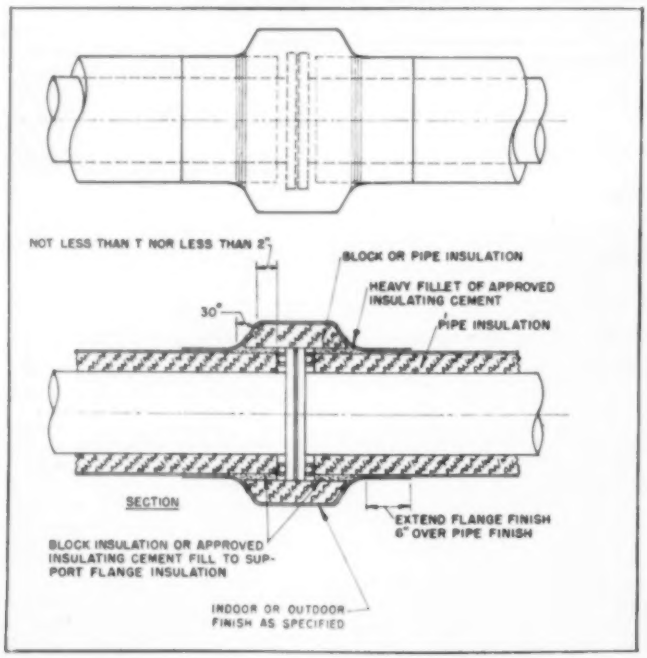
Method 2—Installations where operating temperature is below surrounding air temperature.

Method 3—Installations where operating temperature, though generally in the atmospheric temperature range, may at times be above or in the hot range.

Method 4—Where sprayed, troweled, or brushed mastic insulations are used.

Installation according to Method 1 should be similar to most high temperature applications because the vapor barrier on the outer surface is not important. The higher operating temperatures cause the vapor pressure to push outward and a barrier on the outer surface would only tend to trap the moisture in the insulation. This method of application is shown on Vessel 2, Figure 1B. The block or blanket insulation should be installed with joints tightly butted, and be secured in place by studs, clips, strapping, or wire as desired. Water-mix cement may be used to fill cracks between the blocks or blankets or for leveling, but the use of this cement should be kept to a minimum since the drying time will be lengthened at these operating temperatures. Hydraulic-setting insulating cement may be used to advantage in this application. Outer finish indoors should be of cement reinforced with netting, or canvas, which ever is desired. Insulation located outdoors must be thoroughly dry when weatherproofing is applied. Weatherproofing should consist of a lapped asphalt felt or a sprayed, bushed or troweled mastic finish. Special provisions should be made to protect bands, wire, or netting under the weatherproofing. Any moisture in the insulation will be forced outward and condensation will occur under the weatherproofing. This condensation can cause severe rusting of any steel located directly under the weatherproofing.

Figure 3. Application of Insulation To Line Flange. Atmospheric Temperature Range (Operating Temperature Above Ambient Temperature).


NOT LESS THAN T NOR LESS THAN 2"
BLOCK OR PIPE INSULATION
HEAVY FILLET OF APPROVED INSULATING CEMENT
30°
PIPE INSULATION
SECTION
EXTEND FLANGE FINISH 6" OVER PIPE FINISH
BLOCK INSULATION OR APPROVED INSULATING CEMENT FILL TO SUPPORT FLANGE INSULATION
INDOOR OR OUTDOOR FINISH AS SPECIFIED

Application Method 2 is for insulation of equipment with an operating temperature that is generally lower than the surrounding air temperature. Since, in this case, the vapor pressure caused by the higher surrounding air temperature is inward, it is necessary to have a vapor barrier on the outer surface of the insulation to resist entrance of the vapor. Preventing moisture vapor from entering the insulation and condensing on the equipment is very important. At operating temperatures above freezing but below surrounding air temperature such moisture passing through the vapor barrier will condense.

If the equipment is steel or iron, severe rusting will occur unless the surface is treated with a rust preventive. The rust preventive must be applied before the insulation is installed. After the surface is prepared the block or blanket insulation should be installed with all edges and ends tightly butted together and secured with clips, wire, strap or twine best suited for securement. Metal fastenings should not extend from the equipment to the outer surface as they will cause cold spots on the outer surface at which points condensation will occur. Iron wire and steel strap are subject to

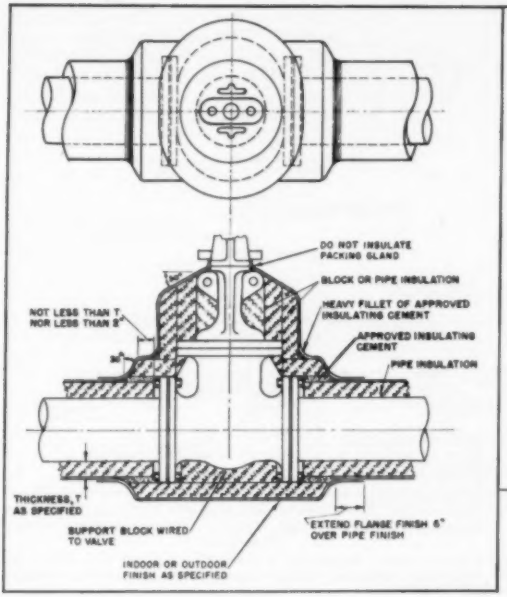

DO NOT INSULATE PACKING GLAND
BLOCK OR PIPE INSULATION
HEAVY FILLET OF APPROVED INSULATING CEMENT
APPROVED INSULATING CEMENT
PIPE INSULATION
NOT LESS THAN T, NOR LESS THAN 8"
THICKNESS, T AS SPECIFIED
SUPPORT BLOCK WIRED TO VALVE
EXTEND FLANGE FINISH 6" OVER PIPE FINISH
INDOOR OR OUTDOOR FINISH AS SPECIFIED

Figure 4 (left). Application of Insulation to Flanged Valves. Atmospheric Temperature Range (Operating Temperature Above Ambient Temperature).

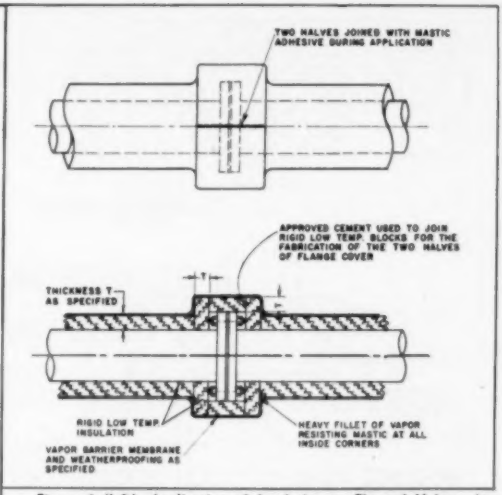

TWO HALVES JOINED WITH MASTIC ADHESIVE DURING APPLICATION
APPROVED CEMENT USED TO JOIN RIGID LOW TEMP BLOCKS FOR THE FABRICATION OF THE TWO HALVES OF FLANGE COVER
THICKNESS T AS SPECIFIED
RIGID LOW TEMP INSULATION
VAPOR BARRIER MEMBRANE AND WEATHERPROOFING AS SPECIFIED
HEAVY FILLET OF VAPOR RESISTING MASTIC AT ALL INSIDE CORNERS

Figure 5 (above). Application of Rigid Insulation To Line Flange. Atmospheric Temperature Range (Operating Temperature Above Ambient Temperature).

rusting and must be protected. Where dissimilar metals are used, particularly rust resistant metals, care must be taken to prevent galvanic currents being set up.

If the equipment happens to be of aluminum, special care must be taken to prevent this action. Where metals dissimilar to the equipment are used for securement, an insulation highly-resistant electrically must be provided to protect the equipment from galvanic action. Where cellular glass, which has high electrical resistance in addition to being a thermal insulation, is used, care must be taken to seal the joints with a satisfactory electrical resistant mastic to prevent moisture in the joints completing the electrical circuit.

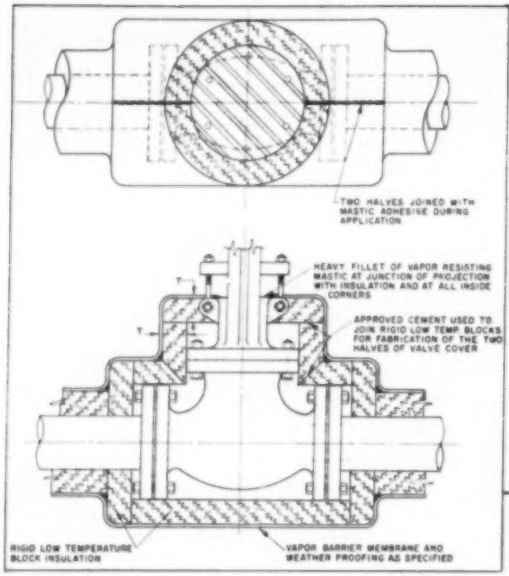
After the insulation is applied, properly sealed and secured, the vapor membrane is applied to the outer surface. The vapor membrane must completely cover the surface and must extend to and be completely sealed to any projections through the insulation. This membrane may consist of tape and sealing compound, it may be a brushed, trowled, or sprayed vapor-resistant mastic, or it may be lapped and sealed vapor-resistant felts or sheets or any combination of the three. Some vapor barriers are not good weatherproofings and, where equipment is located outdoors, barriers of this type must be protected by a weatherproofing material. The weatherproofing may consist of cut-back or emulsified asphalts, mastic compounds, felts or sheets. When sprayed, troweled or brushed weatherproofing is used over a vapor barrier it must have good adhesion to the vapor barrier or trouble will develop.

Application Method 3 applies where the equipment generally operates between 32° and 212° F., but for periods of time is operated in excess of these temperatures. Where this occurs, if the highest temperature exceeds the temperature limits of the insulation used for the 32° to 212° F. range, an additional insulation is required to protect the atmospheric temperature insulation from the high temperature. A schematic diagram of this condition is shown in Figure 2. The thickness of the inner layer high temperature insulation must be sufficient to produce a temperature drop which will bring the temperature down to the range of the outer atmospheric temperature material. This inner layer insulation should be sufficiently resilient to absorb the movement resulting from expansion and contraction of the equipment, without transmitting it to the outer insulation. The iner layer insulation should be strapped or wired into place, as required. The outer layer of insulation should be installed over the inner layer in the manner called for in Method 1 or Method 2, depending upon the general operating temperature level.

Application Method 4 is determined not by the operating temperature but by the type of material selected. This method is used for the application of mastic insulation. Sprayed, troweled or brushed mastic insulation can be used to quite an advantage where the factors are such that some insulation is needed and built-up block or blanket installation is not economically justified. The mastic insulations consist of asphaltic or Gilsonite compounds mixed with cork or vermiculite granules. The surface of the equipment to be insulated must be clean and dry. A rusty surface should be cleaned by sand blasting or another available method. Where a priming material is required to obtain good adhesion to the working surface it should be used as directed by the manufacturer before application of the mastic. For large areas, the most economical method for application of mastic insulation is spraying. The insulation mastic should be sprayed on the surface to the required thickness with allowance made for shrinkage. Where final thickness exceeds one-fourth inch it may be necessary to apply the mastic in two or more coats. In most instances these mastics should be applied to a surface at a temperature between 40° to 140° F. It is not advisable for the material to be applied when ambient air temperature is less than 40° F. When thoroughly dry, most mastics will withstand temperatures from —40° to +300° F. No outer weatherproofing is required as the mastic insulating cements are weather resistant and water repellent.

Piping application specifications are divided into four methods similar to the equipment application specifications and for the same reasons.

Application Method 1, like equip-


TWO HALVES JOINED WITH MASTIC ADHESIVE DURING APPLICATION
HEAVY FILLET OF VAPOR RESISTING MASTIC AT JUNCTION OF PROJECTION WITH INSULATION AND AT ALL INSIDE CORNERS
APPROVED CEMENT USED TO JOIN RIGID LOW TEMP. BLOCKS FOR FABRICATION OF THE TWO HALVES OF VALVE COVER
RIGID LOW TEMPERATURE BLOCK INSULATION
VAPOR BARRIER MEMBRANE AND WEATHER PROOFING AS SPECIFIED

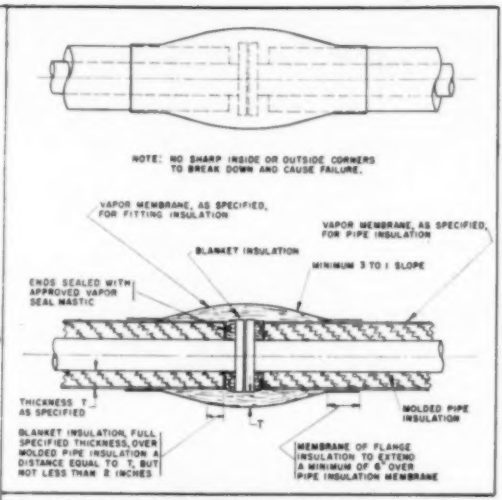

NOTE: NO SHARP INSIDE OR OUTSIDE CORNERS TO BREAK DOWN AND CAUSE FAILURE.
VAPOR MEMBRANE, AS SPECIFIED, FOR FITTING INSULATION
VAPOR MEMBRANE, AS SPECIFIED, FOR PIPE INSULATION
BLANKET INSULATION
MINIMUM 3 TO 1 SLOPE
ENDS SEALED WITH APPROVED VAPOR SEAL MASTIC
THICKNESS T AS SPECIFIED
T
MOLDED PIPE INSULATION
BLANKET INSULATION, FULL SPECIFIED THICKNESS, OVER MOLDED PIPE INSULATION A DISTANCE EQUAL TO T, BUT NOT LESS THAN 2 INCHES
MEMBRANE OF FLANGE INSULATION TO EXTEND A MINIMUM OF 6" OVER PIPE INSULATION MEMBRANE

Figure 6 (left). Application of Rigid Insulation To Flanged Valves. Atmospheric Temperature Range (Operating Temperature Below Ambient Temperature).

Figure 7 (above). Application of Blanket Insulation to Line Flange. Atmospheric Temperature Range (Operating Temperature Above Ambient Temperature).

ment, is for lines operating at temperatures above the surrounding air temperature. Application of the insulation will be similar to that described in Part III (PETROLEUM REFINER, March, 1952) for high-temperature lines. The line shown in Figure 1B between Vessels 1 and 2 is typical. One main difference exists between this temperature range and the high temperature range. This difference is less outward vapor pressure present, to keep the insulation dry, because of the smaller temperature differences. For this reason rusting of steel pipes is much more likely to occur at this temperature range than at the higher level. To protect steel pipe it is well to treat the pipe surface with a rust inhibiting coating before the insulation is applied. The insulation should be applied with all joints tightly fitted and butted and be secured in place with strap, wire or other satisfactory medium. Where wire is used it must be drawn tight and the twisted ends embedded in the insulation to leave no projections which may puncture surface finish or cause injury to personnel. Fittings should be insulated with pipe insulation, block or blanket, as the case may be. Fitting insulation should be secured in place similarly to method used for piping. Water-mixed insulating cements may be used to fill cracks and voids but use should be held to an absolute minimum since usually little heat is available for drying. Again a hydraulic-setting insulating cement may sometimes be used to advantage in place of the heat-drying insulating cement. Indoor finish may consist of finishing cement or canvas jacket; outdoors the finish must be weatherproofed, thus requiring a jacket of felt, sheet, or sprayed, brushed or troweled mastic weatherproofing. Consideration must be given to protection of the concealed metal wire and strap against rusting since condensation of moisture on the under side of the weatherproofing can cause failure of the holding materials. Typical application of a line flange and valve at this operating temperature is shown in Figures 3 and 4.

Application Method 2 is used to insulate pipe operating above freezing but below surrounding air temperatures. As in all cases of atmospheric operation any moisture which condenses on the surface of a steel pipe is liable to cause rusting. As previously mentioned, rust-resistant coatings on the pipe should be applied before insulation of the line is begun. Insulation used at this operating temperature level should be of the low temperature type resistant to deterioration from moisture. The pipe insulation should be installed with joints fitted and tightly butted to eliminate unnecessary voids. Where sealing compound is used to cement joints, as in the use of a rigid insulation such as cellular glass, it must be moisture-free and resistant to moisture migration. Wire and strap used to secure the insulation should be of a rust-resistant material. However, where the wire or strap is of dissimilar metal to the pipe a highly resistant electrical insulation should be installed between the two to prevent setting up galvanic currents. Fittings may be insulated with rigid block, preformed insulation or blanket insulation. Whichever insulation is used should be carefully fitted with all joints tightly butted together. No water-mix insulating cement should be used on the pipe or fitting insulation. A vapor barrier should be applied over the outer surface of pipe and fitting insulation. This membrane may consist of a vapor-resisting mastic, friction tape sealed with suitable compound or jackets of metal or vapor-resisting felts carefully sealed at the joints. A combination of vapor barriers may be used such as jackets over regular pipe surfaces and mastics over irregular fitting surfaces. Where two types of barriers are used one should overlap the other at their junction to insure a complete seal. Outdoor piping and fittings will require weatherproofing protection over the vapor membrane if it is not weather resistant. Weatherproofing should be applied as previously outlined. A typical application of rigid insulation on fittings and the location of the vapor barrier is shown in Figures 5 and 6. A typical application of blanket insulation on fittings and the proper placement of a vapor barrier is shown in Figures 7 and 8.

Application Method 3 is used where the operating temperature may be raised beyond the ordinary temperature limit of this range for an extended period. No inner layer of cushion insulation should be installed on piping

as is occasionally required on equipment insulation, because the circumferential expansion of pipe is normally within the manufacturing clearances of pipe insulation. No cushioning material is necessary in the absorption of longitudinal expansion of the piping since damage to the insulation can be avoided through the use of slip joints built into the insulation. This is seldom required since expansion becomes a problem only on long straight runs. The insulation selected for this installation must be able to function at the maximum temperature without breakdown. The insulation shall be applied by Method 1 or 2, as previously described, depending upon whether the normal operating temperature is above or below the ambient or surrounding air temperature. The only other precaution to be considered is where the operating temperature requires the use of a vapor barrier as described in Method 2. Care must be taken to stop a sufficient distance from any hot surfaces any flammable materials used in the vapor membrane so that no fire hazard will exist when the line operates at maximum temperature.

Application Method 4 for piping, as in the case of equipment, is a method to provide insulation where the economic factors do not warrent the use of sectional or blanket insulation. The surface of the pipe and fittings must be clean and dry. The insulation, consisting of an asphaltic or Gilsonite compound containing vermiculite or cork granules, should be sprayed, brushed or troweled to the desired thickness on the piping and fittings. Temperature limitations and other considerations are as described in application Method 4 for equipment.

Field application of insulation in this temperature range is more difficult than is at first apparent. The application is not the same as used for high temperatures nor is it the same as used for low temperatures. Even where the operating temperature is higher than the ambient temperature it is important that the insulation be kept dry before, during and after installation. If any insulation becomes wet it should be removed and replaced with dry insulation. At operating temperatures below 212° F. the drying time, owing to the operating temperature, is too long to wait for the application of weatherproofing. At operating temperatures below ambient air temperature insulation will never dry, except under rare atmospheric conditions, once it becomes wet. Although the thickness of insulation in this temperature range is minimum, owing to the slight temperature difference, the damage which might be caused by improper application is great. Not only will improper

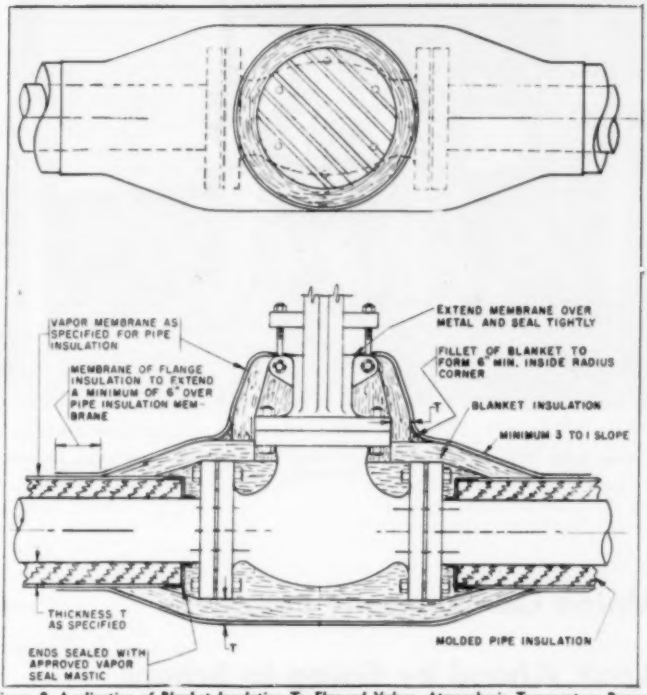

VAPOR MEMBRANE AS SPECIFIED FOR PIPE INSULATION
MEMBRANE OF FLANGE INSULATION TO EXTEND A MINIMUM OF 6" OVER PIPE INSULATION MEMBRANE
EXTEND MEMBRANE OVER METAL AND SEAL TIGHTLY
FILLET OF BLANKET TO FORM 6" MIN. INSIDE RADIUS CORNER
T
BLANKET INSULATION
MINIMUM 3 TO 1 SLOPE
THICKNESS T AS SPECIFIED
ENDS SEALED WITH APPROVED VAPOR SEAL MASTIC
T
MOLDED PIPE INSULATION

Figure 8. Application of Blanket Insulation To Flanged Valves, Atmospheric Temperature Range (Operating Temperature Below Ambient Temperature).

application cause additional heat loss or gain, as the case may be, but it can cause serious damage to the equipment or pipe on which the insulation is installed.

Field inspection of insulation application within the atmospheric range requires a complete check of all phases of the application. First, before any insulation is installed it is necessary that all equipment and lines are properly treated with rust and corrosion-resisting coatings as specified. Second, the insulation must be properly fitted and secured. For any securement which might cause galvanic action, corrective measures must be taken before the insulation application proceeds. Third, the insulation should be checked before and after application to be sure that it is in a dry state. Fourth, the insulation must be checked just before the application of the vapor barrier or the weatherproofing to determine if it has been maintained in a reasonably dry state. Fifth, the vapor barrier should be completely inspected to determine whether any breaks or cracks are present which would prevent obtaining a complete seal. Particularly close attention must be given to the inspection of inside corners, junctions of materials, joints, projections and under surfaces to detect faults in sealing. Good field inspection can save expensive but improperly insulated equipment from premature removal from service.

In most instances good maintenance lies in the making of small repairs before they grow to be extensive. If the weatherproofing and vapor membrane is maintained free from holes and breaks, efficient life of the insulation will be much longer than if no attention is given to weatherproofing or vapor barrier. If, however, a break occurs and goes unnoticed until the insulation around the break becomes wet, the wet insulation should be removed and replaced with dry insulation before damage can spread. When necessary to replace insulation, care must be taken to fit tightly and securely the replacement insulation into the existing insulation, offsetting where possible. The vapor membrane must be replaced and sealed to adjacent membrane, and any cut-away weatherproofing must be replaced. The best maintenance is low cost maintenance. A most important caution to be observed: Increase the frequency of inspection and remove all insulation at the first sign of corrosion after piping or equipment is removed from service for an extended period.

End of Part V. Part VI will appear in an early issue.

—Photo courtesy Union Oil Company of California.

Stillman Robert Haire and Foreman Everett Freligh find both school and recess pleasantly instructive.

Union Oil Company Employes Look Ahead by Going to School

SAID the engineer to the stenographer: "Tell me how hexane differs from methane."

She replied: "Hexane differs from methane only because the hexane molecule contains six carbon atoms instead of one, and also . . ."

That an engineer should have sought—and obtained—such information from a stenographer occasioned no surprise among the 50-odd people present, for this was an adult class in petroleum processing at Harbor Junior College, Los Angeles. The instructor was Gale S. Peterson, engineer in the Refinery Process department of Union Oil Company of California's Los Angeles refinery, and the students were employes from the same plant.

It all started about a year ago when personnel men at Union's Los Angeles and Oleum refineries decided that many employes wanted to know more about their plants, their company, and their industry.

Trained for specific jobs, too few had any idea of the broader aspects of their work. To a stenographer, a refinery was a typewriter; to a machinist, a refinery was a lathe; to a welder, a refinery was a torch.

Why not broaden these employes with regular classes? Management approved; the Contra Costa and Harbor Junior Colleges offered their facilities; and on the plant bulletin boards went notices of classes in a general introduction to refining units, feed stocks and processes.

More than 50 employes, including several foremen, registered for the class at Harbor Junior College and took their exams in January. In February, the initial class was promoted to an advanced course and a repetition of the starting course was offered to newcomers.

The arrangement with Contra Costa Junior College resulted in the awarding of 65 certificates of completion to employes of Oleum Refinery on February 7—the largest industrial group to complete such an adult education course in that area. Fifty-nine of the class are continuing through an advanced course of petroleum technology during the current semester and are eligible for college credits.

Though the classes are exclusively for Los Angeles and Oleum refinery employes, Union Oil does not compensate the colleges other than through normal tax channels. The colleges also pay the salaries of the instructors, including that of Engineer Peterson, who was required to qualify for a California teacher's certificate.

Cost to the students is $2.50, which also admits them to their school's athletic contests.

As outlined by Peterson, the objectives of the course are 1) to provide a general knowledge of all phases of petroleum processing; 2) to promote a better understanding of the workings of each unit in the Los Angeles Refinery; 3) to clarify the interrelationships of each unit, showing its dependency on the others; and 4) to give an appreciation of background topics such as the nature, occurrence, production, chemistry, separation, and manufacture of petroleum products.

The course is introduced with a study of the history and origin of the petroleum industry. Attention is given to geology and related sciences as the class follows the flow of oil through exploration, drilling and production. Some time is spent on topics closely related to production, including conservation practices, dewatering, desalting, field separation, cycling and other field processing methods.

Outline of Course

Next comes a general description of methods for separating crude into gas, gasoline, kerosine, diesel, lube base stocks and intermediate products. A brief outline is given of the field of organic chemistry and chemical reactions, with emphasis on petroleum hydrocarbons. Finally comes the treatment of the products and specific processes used to remove undesirable constituents.

Movies, slides and models are used extensively in presenting the class material.

This course typifies the college-industry educational programs described by Raymond J. Casey, director of Los Angeles Harbor Junior College, as "the most important contribution that a community college can make to the area it serves . . ."

The value of the course was summed up by a student as follows: "Since my job is rather specialized, I have little opportunity to find out what goes on in the rest of the refinery and just exactly how my work fits in with overall operations. At first I thought the course might be too technical for me since I only have a high school education, but the organic and physical chemistry involved and the various refining processes have been explained in such a way that I have even surprised myself with the degree to which I have been able to understand these things. This, of course, has made my job much more interesting."

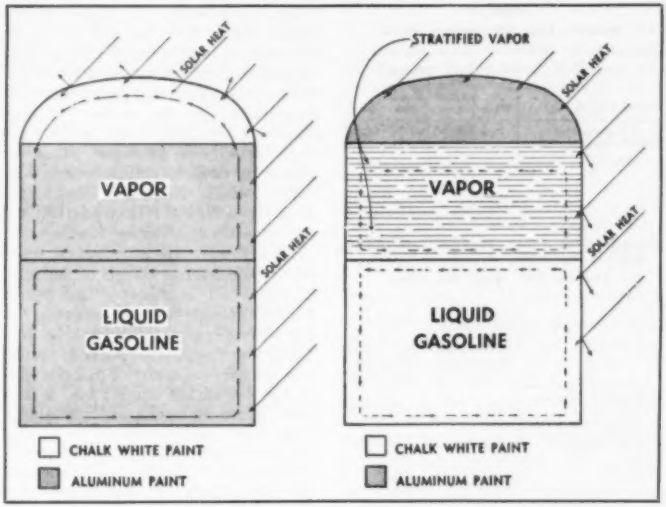


FIGURE 1 (left). When sidewalls of cone roof tanks are painted aluminum and roof painted white, convection currents are set up in the two phases inside tank, which result in high evaporation and large volume breathing.

FIGURE 2 (right). When top of tank is painted dark color and sidewalls painted white, there is less convection. The vapor tends to stratify and heat entering roof provides its own insulation, primarily effecting thermal expansion characteristics of vapor. Best of all—paint tanks solid white.

White Paint Cuts Losses On Petroleum Products Storage

Tests just completed indicate saving of $1500 per year for each 80,000-barrel gasoline storage tank

S. S. SMITH and G. D. HARDEN
Shell Oil Company, New York

EVAPORATION losses—which may run into terrific debits—can be cut sharply by painting products storage tanks solid chalk white. The white paint reduces temperatures inside the tanks on hot days, minimizes breathing, and reduces convection currents inside the tanks.

Tests recently concluded by Shell Oil Company also indicate that a solid white tank is more efficient than a "two-toned" tank. Contrary to popular belief, if two colors are used on a tank it is far better to paint the sides white rather than the roof. This article reports the quantitative effects of reflective roof and side wall paints on total tankage losses.

The test was divided into three parts as follows:

- Twelve drums were painted white, aluminum and black. Each was half filled with gasolines of various vapor pressure grades in each color. They were weighed daily to determine losses.
- A pilot tank farm with 1000-gallon tanks was constructed. The tanks were painted various colors as required. Accurate measuring devices, for both liquid and vapor losses and for air intakes, were installed on each tank.
- Two 80,000-barrel, cone roof tanks were used in one experiment to verify the validity of quantitative data derived from the pilot tank farm. (The exception noted above to the completion of this data is one further experiment to be conducted in 80,000-barrel tanks to confirm the relationship between the effects recorded in the pilot tank farm and in full-scale commercial operation.)

While the experimental tank farm was being constructed the relative loss was predetermined by a study of 50-gallon drums painted white, aluminum and black. Twelve 50-gallon drums were painted in units of three with chalking white, black, aluminum and artificially weathered aluminum paint.

The three-barrel units, each assigned a given paint, were filled half full with 8.8, 12.1 and 13.8 Reid Vapor Pressure motor gasoline. Each day the drums were weighed to within plus or minus $\frac{1}{8}$ of a pound. The total weight losses for the period of the test were used to develop the loss figures relative to the chalking paint (Table 1).

In order to substantiate and lend more credence to the drum data, investigation with the experimental tank farm started in the fall of 1950. The purpose was to determine product loss relative to a white cone tank for a weathered aluminum cone roof tank, a black cone tank, and a white lift roof tank having a lift capacity equal to 28.5 percent of the volume of the tank.

The tank farm was built around tanks having 1000 gallon shell capacity, and originally consisted of three cone roof tanks, a lift roof and a floating roof tank. The floating roof tank was dropped from the study because of inability to develop a seal tight enough to insure correlation with the performance of the parent commercial tank. Each tank is located on a chat pad and calibrated with water using Bureau of Standards calibration cans. The tanks were fitted with gauge glasses for liquid measurement and positive displacement gas meters to measure the venting and breathing action in the vapor phase. Thermocouples were installed by which continuous reading could be made for liquid and/or vapor temperatures. For the purpose of these investigations, the model tanks were half filled with 13 to 14 pounds RVP gasoline.

The results of this study are summarized in Table 2.

Supplementing Study No. 1, the tanks were emptied, gas freed and filled with air so that the metered measurements of the breathing and venting action were a direct index of the amount of solar heat absorbed and

radiated by each color of tank paint. The relative ratios of the breathing action of the tanks filled with atmosphere are noted in Table 3.

Comparing these two initial investigations, it is noted that while there is the same order of difference in the relative effects of heat absorption by the black, aluminum and white coatings, the magnitude of the difference in the study including both liquid and vapor phases is greater than in the study with air alone. In the single phase air study, the relative ratios decreased from 1.8 to 1.5 for weathered aluminum and from 2.4 to 1.7 for black paints respectively. This decrease or relative factors for the single phase air study, is attributed to the elimination of heat absorption by a liquid phase with its attendant vapor expansion. These losses are those which result from changes in vapor pressure and are additive to the breathing losses. It is apparent that this latter effect contributes almost as greatly to the total venting and breathing action of the storage tank as does the natural thermal contraction and expansion of the vapor.

These facts being recognized, another study was begun in which we compared the relative losses from an all white cone tank with a cone roof tank having a white roof and aluminum sidewalls. The losses from the aluminum and white tank were 1.5 times the loss from the all white tank. Comparing the 1.5 ratio with the 1.7 relative ratio previously developed for an all aluminum tank, we find that painting the roof white, insuring a high degree of reflectivity, reduces the heat absorbed by the vapor, but it does not reduce commensurately the over-all volatile loss; all of which adds additional credence to the proposition that sidewall color is the major factor influencing the magnitude of the loss from motor gasoline storage.

The importance of the color of the shell of a storage vessel is also confirmed by the relation which exists between the temperature rise of the vapor compared to temperature rise of the liquid. In the work with the small tank farm, we find that the temperature of the vapor increases 3° to 4° F. for each degree rise of the liquid temperature. This temperature relationship which is specific for the small tanks, indicates that the liquid phase absorbs 120X the available solar energy absorbed in the vapor phase despite the fact that 60 percent of the tank's surface area is in contact with the vapor phase. This somewhat startling difference in the amount of heat absorbed by the two phases is due in part to the extreme differences between the heat conductivity coefficients for vapor versus liquid films. Also the differences in the rates of heat transfer arising from the thermal convection currents which exist in the vapor and liquid phases of gasoline affects the amount of heat absorbed by vapor. The relatively high capacity of the liquid phase for absorbing heat in comparison to the vapor phase emphasizes again the need for a highly reflective paint for the sidewalls of a storage tank.

TABLE 1
Relative Loss Fifty-Gallon Drums

PAINT COLOR	Chalking White	New Aluminum	Weathered Aluminum	Black
Pounds gasoline lost	16⅛	22½	27¾	37½
Ratio to chalking white	1.0	1.4	1.70	2.30

TABLE 2
Study 1
Experimental Tanks Product Loss Ratios Relative to White Protective Coatings (14 Lb. RVP Motor Gasoline)

	C-1 Black Cone	C-2 Weathered Aluminum Cone	C-3 White Cone	L-1 White Lift Roof
Total Air-Hydrocarbon Vapor Vented	2.0	1.7	1.0	0.2
Total hydrocarbon liquid vented as vapor	2.4	1.9	1.0	0.2
Liquid loss	2.4	1.8	1.0	0.5

TABLE 3
Study 2
Experimental Tanks—Volumes of Air Discharged Relative to White Protective Coatings Atmospheric Air

	C-1 Black Cone	C-2 Weathered Aluminum Cone	C-3 White Cone
Ratios relative to white cone	1.7	1.5	1.0
Percent total solar heat absorption—Black cone tank as reference	100%	88.0%	59.0%

TABLE 4
Study 3
Experimental Tanks Product Loss Relative to White Cone Tanks 14 Lb. RVP Motor Gasoline

	C-1 White Roof Weathered Aluminum Sidewalls	C-2 Weathered Aluminum Roof, White Sidewalls	C-3 All White
Total air-hydrocarbon vapor vented	1.6	1.2	1.0
Total hydrocarbon liquid vented as vapor	2.0	1.3	1.0
Liquid loss	2.0	1.3	1.0

TABLE 5
Study 4
Experimental Tanks Vapor Phase and Liquid Temperatures. Time 1200 Hr.

	C-1 White Roof Weathered Aluminum Sidewalls	C-2 Weathered Aluminum Roof, White Sidewalls	C-3 All White
Average temperature 4" below roof	60.5° F.	63.4° F.	56.2° F.
Average temperature vapor phase	58.2° F.	57.0° F.	52.0° F.
Average temperature 1" below liquid surface	50.1° F.	46.0° F.	46.0° F.
Average liquid temperature	45.5° F.	42.0° F.	42.0° F.
Atmospheric temperature	47.0° F.	47.0° F.	47.0° F.

In order to demonstrate more clearly the relative effects of the solar energy which is absorbed and transmitted through the roof compared to the sidewall areas of a tank, a final study was made. The purpose of this was the development of relative loss factors for an all white tank, a tank with white sidewalls and an aluminum roof, and finally a tank with aluminum sidewalls and a white roof. The results, outlined in the chart, Study 4 (Table 5), graphically portray effects of the color of a tank's sidewall on the over-all loss picture. Relative loss ratios of 1.6 for air vapor and 2.0 for liquid are shown for the tank with the aluminum sidewalls, C-1, which approach in magnitude the relative losses previously arrived at for a weathered all-aluminum tank. In sharp contrast are the relative ratios of 1.2 for vapor and 1.3 for liquid losses developed for the tank with the aluminum roof and white walls, C-2. These latter ratios indicate greater heat absorption by the aluminum surface, but, despite this energy absorption, they are comparable to an all-white tank and almost exactly match the relative loss factors assigned to a new aluminum finish before weathering.

Interesting Contrast

Another interesting contrast in the relative effects of the choice of color for a tank's sidewall and roof is found in a comparison of the vapor and liquid temperature for the three test tanks. The temperatures shown in Table 4 were taken from the data for the days having a maximum solar radiation. In line with the consistently high rate of heat absorption by a weathered aluminum finish, it was found that the greatest vapor temperature normally occurs just below the aluminum roof, tank C-2. However, comparing the over-all average temperatures for the respective tanks' vapor phases, it is noted that this temperature relation tends to reverse and the temperature for the tank with the white roof and aluminum sidewalls (C-1) is just slightly higher than the over-all temperature of the vapor phase under the aluminum roof (C-2). This result shows clearly

the effect of convection currents generated by the aluminum sidewalls versus the insulating effect of the hot non-circulating vapor under the aluminum roof.

Another significant factor to be noted in the temperature analysis is found in the exact comparison of the liquid temperature for the two white sidewall tanks notwithstanding the fact that the temperature of the vapor phase directly below the aluminum roof is some 5° F. greater than for the all white tank. Also worthy of note is the 3°-4° F. difference in liquid temperatures which is recorded for the aluminum and white sidewall tanks.

By way of review, we have established the fact that solar energy is available along the approximate horizontal plane of the roof and along the vertical plane of the tank's sidewalls. It is the energy transmission through the latter plane which accounts for the major portion of the heat energy which is converted to volatile loss from storage. The effectiveness of the sidewall transmission is a function of high heat transfer coefficients and thermal convection currents which abet the transfer of available sidewall energy to the two phases of gasoline. This absorption of sidewall energy (Figure 1) reduces the stratification of heavy hydrocarbon vapors near the liquid vapor interface and augments the natural breathing and venting of the tank by the constant readjustment of the liquid's effective vapor pressure. In contrast, the transfer of energy downward from the roof area (Figure 2) primarily affects only the thermal expansion characteristics of the vapor, and tends to be self-insulating.

It must be conceded that the data derived from pilot plant tanks did not have tangible quantitative value because of the small size of the storage. This left a reasonable doubt as to the applicability of the relative factors when projected to commercial storage. To dispose of any of these doubts, it was undertaken to develop the relative loss relationship between two 80,000-barrel, cone roof tanks—one recently painted aluminum and the other all white. Both tanks were half filled with 40,000 barrels of 10.5 RVP gasoline of identical specification.

The two tanks were equipped with gas meters and recording thermometers for the measurement of the volume of breathing and venting. The mechanical vents on both tanks were sealed to insure that all vapor and air leaving or entering the tanks would be measured by meter.

Since a cone roof tank is a storage vessel for *two phases* of gasoline, an adequate picture of the relative effects of solar heat absorption necessitates the taking of data which will be a measure of the losses from both the liquid and the air-hydrocarbon vapor mixture. To meet this requirement, the following data were taken from each of the two 80,000-barrel tanks for the period of the investigation:

TABLE 6
Study 5
Relative Loss 80,000 Barrel Cone Roof Storage One-Half Full 10.5 RVP Motor Gasoline

QUANTITY MEASURED	Time Period	New Aluminum Paint	White Paint	Ratio Aluminum To White
Volume H.C. vapor vented, Ft.³ 60° F./760 mm Hg.	9/24 to 10/6/51	193,334 ft.³	148,010 ft.³	1.3
Average percent expansion vapor phase	9/24 to 10/6/51	6.4%	4.7%	1.4
Average gallons per 100 ft. ³ vapor	9/23 to 10/3/51	10.0 gal./1000 ft.³	7.9 gal./1000 ft.³	1.3
Barrels of gasoline lost as vapor	9/24 to 10/6/51	46 barrels	28.0 barrels	1.6
60° F. barrel liquid lost (tank gauge)	9/24 to 10/6/51	76.0 barrels	59.0 barrels	1.3
Liquid loss during initial time period heat absorption period	9/19 to 9/23/51	35.0 barrels	18.0 barrels	1.9
Over-all liquid loss	9/18 to 10/6/51	110 barrels	77.0 barrels	1.4
Percent liquid lost determined by Chenicek Whitman apparatus	9/24 to 10/6/51	0.265%	0.20%	1.3

Vapor Phase

- Volume of hydrocarbon vapor vented, measured by positive displacement gas meters.
- Gallons of liquid gasoline per 1000 ft.³ of hydrocarbon vapor, measured by the determination of the specific gravity of vapor samples and the conversion of specific gravity to liquid gallons/1000 ft.³ vapor.

Liquid Phase

- Barrels of liquid lost, measured by float gauge and the midpoint temperature of the liquid.
- Percent of liquid lost, measured by the analysis of liquid samples in the laboratory using the Chenicek and Whitman vapor pressure apparatus.

The over-all time period covered in this study was Sept. 18, 1951 to Oct. 6, 1951. This period was divided into two parts, Sept. 18, 1951 to Sept. 23, 1951, inclusive, and Sept. 24, 1951 to Oct. 6, 1951, inclusive. The first was a period of heat absorption in contradistinction to the cooling and radiation observed during the second period. The relative losses developed for the two phases of gasoline are summarized in Table 6.

These results confirm the 1.3 relative ratio previously developed for a new aluminum finish which substantiates work with replica storage and justifies the use of the ratio factors derived from experimental tank farm as a prognosis of the relative behavior of commercial storage.

From these somewhat involved studies, it is felt that enough information has been derived to set forth recommendations basically essential to establishing a sound product conservation program. It is obvious throughout this work that the magnitude of the venting and breathing action, entailing a daily loss of product, is a direct manifestation of the amount of solar energy absorbed by the vapor and liquid phases of the storage product. The roof and the sidewalls of the tank provide the media for the absorption and direct transmission of solar heat; however, due to the differences in heat transfer characteristics and the relative effects of energy absorption within the two phases of gasoline, we find that the sidewalls of a storage vessel transmit the major portion of the energy which is dissipated in volatile losses from storage.

Control of solar energy absorption obviously rests with the choice of the color of the protective coating assigned to the storage vessel. The most effective coating for the control of losses is a white paint for the roof and sidewalls; comparable to this, but not approaching the overall effectiveness of the all white paint system, is the two color system which embodies an aluminum roof with white sidewalls.

The extra cost of white paint, assuming half the life for white paint as compared to aluminum, is perhaps $200 to $250 per year on a three-year recoat basis for a typical 80,000-barrel tank. By conservative use of the data in Study 1 the losses sustained under aluminum exceed those under white paint by perhaps 350 barrels per year for the typical 80,000-barrel tank. This represents $1750 per year in losses for motor gasoline, and retains a net saving of $1500 per year per tank after charge off of additional paint cost.

If severe atmospheric conditions, which cause excessive corrosion, indicate that aluminum roof paint is a must, then the best and most effective compromise is to paint side walls white and the roof aluminum—which is the reverse of usually accepted practice.

ACKNOWLEDGMENT

This article from a paper presented at the API Products Pipe Line Technology conference, April 21-23, 1952, in Fort Worth.

Catarole Process Produces High Yield of Olefin Gas and Aromatics

THE Catarole process is a high-temperature vapor phase cracking process, unusual insofar as it produces simultaneously a high yield of gaseous olefins and a liquid product which is so predominantly aromatic in character that the separation into pure components is comparatively easy.

A commercial plant, designed and constructed by Petrocarbon Ltd., based on this process, has been in operation for some years at the Petrochemicals Ltd. petroleum chemicals plant at Partington Industrial Estate, Manchester, England.

The plant was designed to operate on a variety of charge stocks. At present it charges Middle East naphtha having a boiling range of 120 to 240° C. (248 to 464° F.). The naphtha is converted by cracking into a gas stream of about 52 percent and a liquid stream of about 46 percent by weight on charge.

A typical analysis of the gas stream is shown in Table 1.

TABLE 1

	Weight Percent On Feedstock
Hydrogen	0.4
Methane	15.7
Ethylene	11.6
Ethane	9.6
Propylene	10.2
Propane	1.7
Butylenes	
Butadiene	2.8
Butanes	
	52.0

The analysis of the liquid stream is shown in Table 2.

The actual cracking reaction takes place in the vapor phase at about 1292°F. and at a pressure of between 20-50 psi.

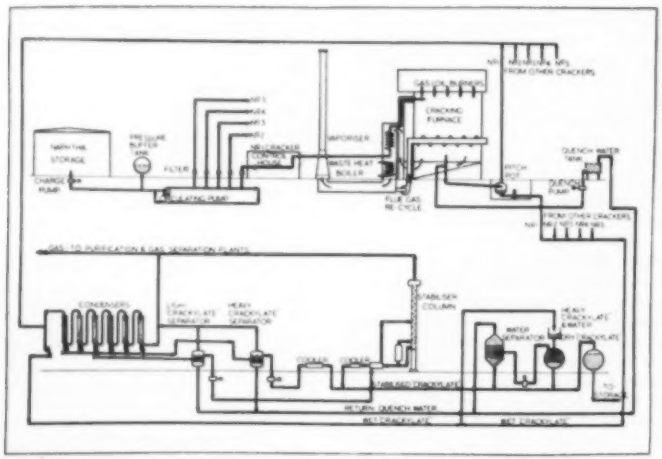


Figure 1. The "Catarole" Cracking Process.

TABLE 2

	Weight Percent On Feedstock
Pre-benzene	1.8
Benzene	5.3
Non-aromatics in benzene boiling range	0.4
Toluene	6.0
Non-aromatics in toluene boiling range	0.3
m- and p-Xylene	3.0
o-Xylene and styrene	2.5
Alkyl benzene	7.1
Fr. naphthalene	1.2
Refined naphthalene	1.0
Alkyl naphthalenes	5.2
Anthracene cut	3.4
Pyrene/chrysene cut	3.4
Hard Pitch M.P. 302/338° F.	4.8
	45.5

Naphtha is first completely vaporized by passing through pipes situated in the convection section of the furnace heated by the issuing combustion gases. The vapor is then fed to the cracking zone which consists of alloy steel tubes arranged vertically in the radiant heated section of the furnace. The cracked material then flows to a reaction section in which the aromatization of the cracked material is completed. At the outlet of the reactors the final products are quenched with water to a temperature of about 248° F.

Removal of Tar

The heaviest tar is removed in the "pitch pot" and the products, together with steam from the evaporated quench water, is led to condenser coolers of special design.

The uncondensed gases pass to the gas separation plant for recovery of the valuable olefins. Water is removed from the light and heavy condensates from which it separates readily and is returned for re-use as quench.

The light condensate is stablized to remove C_3's and C_4's which join the gas stream to the gas purification plant for the removal of H_2S and then on to the gas separation plant.

The stabilized light condensate, together with the heavy condensate, then goes to rundown tanks.

The tars being heavier than water need a special separating system to remove the water before they are mixed with the light and heavy condensates to form the final liquid product.

Normal operation of this cracking process yields a liquid product which, when distilled, gives a crude benzene cut containing 92-94 percent pure C_6H_6 and a crude toluene cut of 94-96 percent aromaticity.

Continuous operation of the cracking unit is assured by the oxidation at the working temperature of the furnace of the carbon which is formed. On-stream times of about eight months between routine shutdowns of these furnaces are normal, but could be, if

necessary, exceeded. The alloy steel tubes themselves can be expected to have a life of many years.

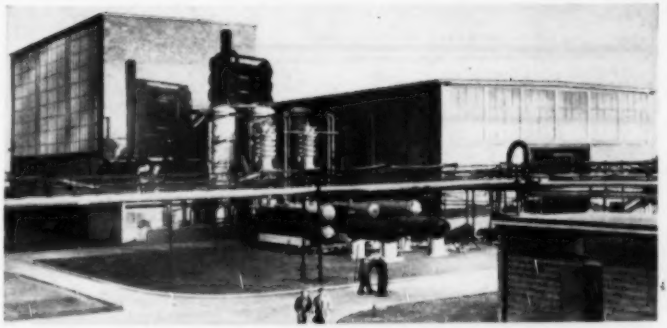
The gas separation plant effects the separation of methane, ethane, ethylene, propane and propylene, and the mixed C_4's from the gaseous products of the Catarole cracking process, by liquefaction of this gaseous product followed by low temperature distillation.

Four Heat Exchangers

Cracker gas, after preliminary compression in two stages and drying, is cooled to such a temperature that the gas in equilibrium with the liquid produced contains a negligible amount of ethylene. The cooling takes place in a bank of four heat exchangers utilizing evaporating liquid propylene at low pressure, ethylene at medium presure, ethylene at low pressure, and methane at medium pressure, and these heat exchangers, together with the first three distillation columns, are contained in a completely enclosed, thermally insulated, cold box.

Liquid from this main cooling bank is fed to Column 1 where methane is taken off as an overhead product. The bottom product from this column is fed to the next column where ethylene and ethane are taken overhead together and fed to Column 3 where ethylene is separated from ethane. This last column works at a relatively low pressure and the average temperature is about —130° F.

The bottom product from Column 2 containing the C_3's and higher is fed to Column 4 for the removal of C_3's and Column 5 for the removal of C_4's, both of which are outside the cold box.



The low temperature gas separation plant. The distillation house, left, the ammonia absorption unit, center, and the compressor house, right.

Ammonia Absorption Refrigeration

The first unit in the chain of refrigeration circuits providing the various temperature levels in this gas separation plant is an ammonia absorption refrigeration plant which in three units gives a cooling effect of 4,250,000 Btu's at a temperature of —58° F. This temperature is sufficient to liquefy ethylene at a pressure of 192 psi, producing a liquid which can be evaporated at either the intermediate or low-pressure stages to give successfully lower temperatures in the cascade cooling bank.

Evaporating ethylene at 17.0 psi gives a temperature low enough to condense methane at a pressure of 497.8 psi which is then evaporated to give the lowest temperature in the cascade sufficient to liquefy almost the whole of the cracker gas.

Propylene is also used as a refrigerant in the plant at two different pressures to transfer heat and cold in a convenient way at high heat transfer rates; by evaporation where cooling is required, and by condensation in some of the column reboilers, as shown in the diagram, so providing heat.

The products from this low-temperature gas separation plant are arranged to give 1) a mixture of hydrogen, methane and ethane, 2) ethylene, 3) a mixture of propylene and propane and 4) a mixture of butanes, butylenes and butadiene.

All the products leave the plant at temperatures above 32° F. having given up their cold by heat exchange. The cold is partly used for sub-cooling the liquid refrigerants to prevent excessive flash gas on expansion and partly to bring down the temperature of the gas on the delivery side of the refrigeration compressors, so contributing to the high thermal efficiency of the whole plant.

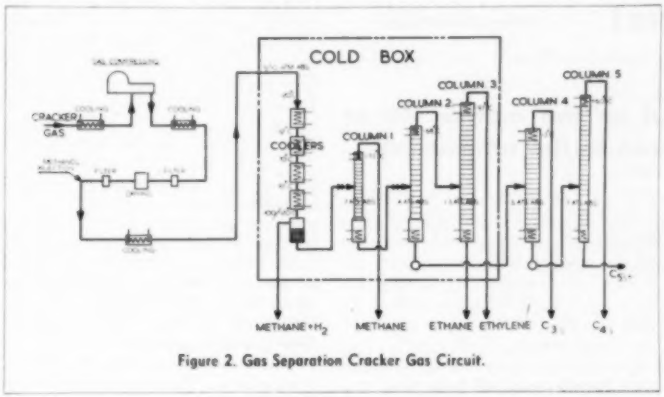


Figure 2. Gas Separation Cracker Gas Circuit.

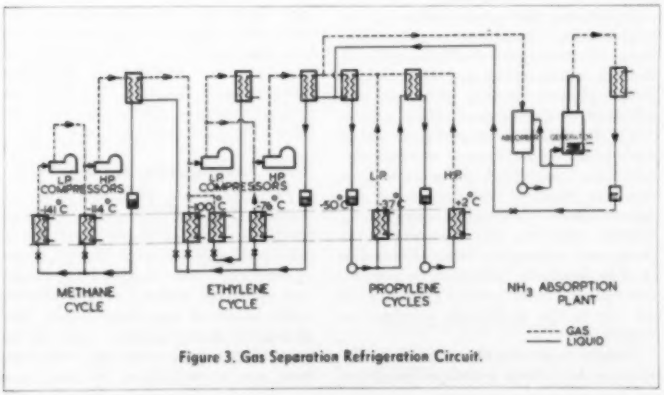


Figure 3. Gas Separation Refrigeration Circuit.

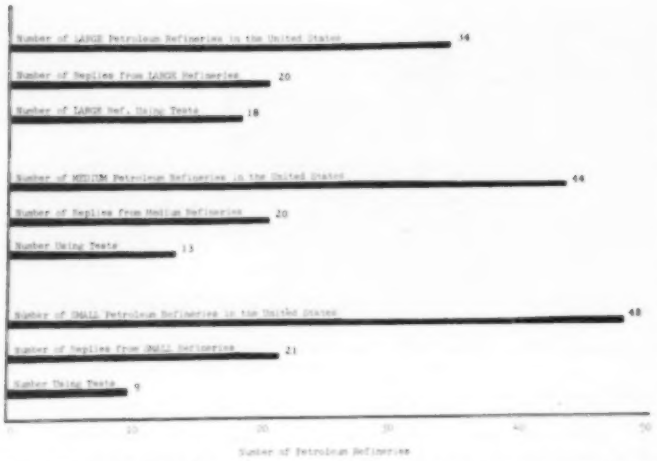


Chart 1. Shows number of refineries in each size category, the number in each category that replied to the questionnaire (all refineries were sent questionnaires), and the number of those replying that use pre-employment tests.

Should Refineries Use Pre-Employment Tests?

Of 126 companies queried on the matter, 40 or nearly one-third answered in the affirmative

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IN VIEW of rising operating costs, refinery management is quick to question the necessity of expenditures which do not show immediate and direct returns. The cost of using pre-employment tests to select better refinery workers is just such an expense. Do refinery managements recognize that the proper use of pre-employment tests can help reduce costs in the long run? A recent study conducted under the direction of the Department of Industrial Engineering at Columbia University indicates that a substantial portion of the petroleum industry thinks so. Personnel managers of 40 of the 126 largest refineries in the United States, in answer to a questionnaire, replied that their companies use tests on prospective employes and find the results beneficial.

Importance of Selection of Personnel

Increasing the productivity of an organization's employes is part of the work of every personnel manager, as well as line supervision. This can be done by concentrating effort on one or more of the normal duties of the industrial relations department which include such functions as recruitment, selection, training, promotion procedures, employe benefits, wage administration, collective bargaining, human relations, etc. The particular personnel technique under discussion in this article is "selection or pre-hiring testing," with special emphasis on its use in the petroleum refining industry.

Selection is roughly defined as the process by which potential employes are separated into two classes: Those to be employed and those who are not to be employed. It is obvious that the characteristics of those applicants who are selected — hired — are important the labor force that can be achieved by devoting effort to other personnel factors in determining the amount of improvement in the productivity of functions. The realization of this fact, plus the general desire on the part of large organizations to use manpower in the most efficient manner possible, has led to the development of a whole body of knowledge on pre-hiring tests.

In the petroleum refining industry productivity has traditionally been considered as a problem relating almost exclusively to the plant and equipment. It is interesting to note that gradually more thought is being given to the human factor of production. One of the largest and most progressive companies in the petroleum industry has established a department devoted entirely to research in human relations. In 1949, the University of Texas in cooperation with the A.P.I.[1] conducted a study on the use of formal training programs in refineries throughout the United States. A most significant fact brought out by that study was the growth in the use of training systems, particularly since World War II. In order to supplement information of the type compiled by the University of Texas study, the subject survey of the use of prehiring tests in the petroleum refining industry was conducted.

As stated above, the results indicate that a large proportion of refinery managements are conscious of the importance of personnel selection, whether or not pre-hiring tests are used. Furthermore, at least one-third of the refineries above 10,000 barrels daily in the United States use pre-hiring tests of some sort as part of their selection program.

The total working force of a 10,000-barrel-daily refinery is usually less than 100 people, so plants smaller than that were not included in the study. This decision was based on the fact that the use of pre-hiring tests usually is not practical if the labor force is small. A list of 126 refineries, prepared from available sources,[2,3] received the questionnaire.

Conducting Survey

Each of these refineries was requested to state whether or not any formal tests were given regularly to job applicants prior to hiring. If the answer was "yes," further information was requested about the type of tests used, types of employes tested, and general opinions on the value of the tests. If the answer was "no," information was requested as to why tests

were not used and how new employes were selected. Of the 126 refineries questioned, 61 answered—almost a 50 percent response. (A reply of 10 to 15 percent is considered normal for mail surveys of this type.[4]) The cooperation of refinery industrial relations departments in responding to this survey could be considered indicative of the interest which many modern refinery managements have in personnel problems.

In order to permit easy comparison of the data compiled in this study with data presented in other studies, refineries were arbitrarily defined as *large* if the crude oil capacity were 50,000 barrels daily or more, as *medium* if the capacity were in the range between 49,000 to 21,000 barrels daily, and as *small* if the capacity were 20,000 barrels daily or less. Based on this breakdown, there were 34 large, 44 medium, and 48 small refineries on the original mailing list.

Analysis of Results of Survey

An analysis of the 61 replies reveals that 40 refineries do use some form of pre-hiring tests. As might be expected, there seems to be a definite relationship between the size of the refinery and the use of these tests. Of the 20 large refineries which sent in the questionnaire, 18 report the use of tests; whereas, in the small category the proportion is only 9 out of 21. Chart 1 summarizes this information.

If a test is used, it is of interest to know the type. Most of the tests used in industry fall in one of the following classifications:

1) *Performance or Skill Tests.* Tests which appraise the individual's actual proficiency as it is.
2) *Aptitude or Potential Skill Tests.* Tests which appraise the special abilities that are of importance on particular jobs.
3) *Trade Background or Knowledge Tests.* Tests which appraise to what extent an individual possesses the knowledge generally characteristic of craftsmen in a particular trade.
4) *Intelligence or I.Q. Tests.* Tests which appraise "intelligence" or mental alertness.
5) *Vocational Interest Tests.* Tests which attempt to relate patterns of interest to success on the job.
6) *Emotional Stability Test.* Tests which attempt to relate the degree of maturity of an individual to success on the job.

Of the 40 refineries which reported use of tests, 28 indicated they use I.Q. tests, 25 use performance tests, and 22 use aptitude tests. The other three types of tests fell considerably below this level of use as 12 refineries stated they use emotional stability tests, 10 use vocational interest tests, and 9 use trade background tests.

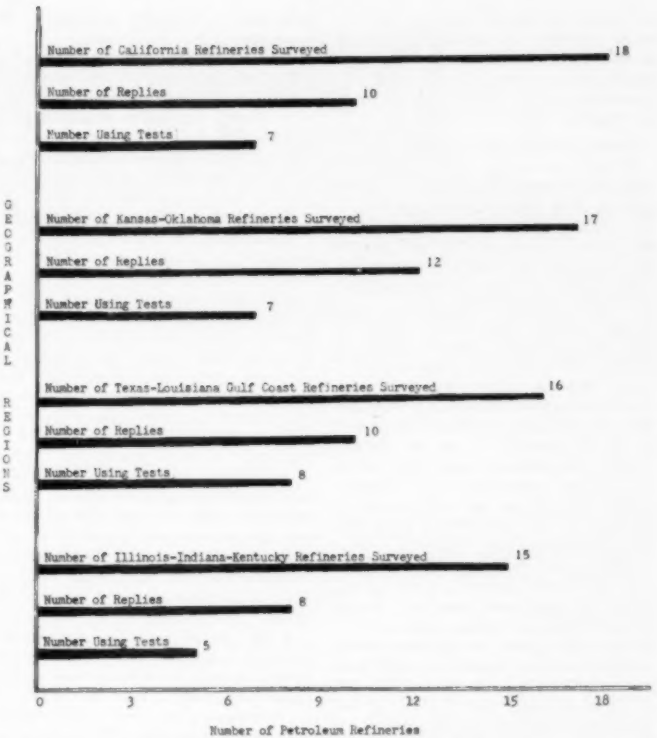

Chart 2. Shows numbr of refineries in the four general geographic regions, the number from each region that replied to the survey questionnaire, and the number of those replying that use pre-employment tests.

A more detailed breakdown of this part of the data revealed that one-fourth of the refineries which use tests have a complete program; that is, they use the emotional stability and vocational interest tests as well as the I.Q., aptitude, and skill tests. In fact, all ten companies which reported the use of vocational interest tests also use emotional stability tests. One might expect these refineries, with elaborate testing programs all to be in the large class, but this is not the case. They are equally distributed as to size, including one refinery with a capacity of only 12,500 barrels daily. However, several of the plants with a capacity of 10,000 barrels daily stated they were too small to use formal pre-hiring tests of any kind.

Department Use of Tests

The working force at most refineries can be divided into three general categories: operations, maintenance, and office. On the question of testing applicants for employment in these major departments 17 establishments test for operations jobs, 25 test for maintenance jobs, and 33 test for office jobs. A closer inspection of these figures shows that of all the refineries using tests, one-third of them test office workers only and for most part do not use anything except performance tests. A few companies reported testing potential sales and technical personnel, and one even reported testing common laborers.

Most of the 40 refineries using tests seem to consider them worthwhile. In the opinion of 31 personnel managers the programs have helped solve some of their personnel problems. However, comments indicated that the use of tests was only part of the selection procedure. Strong reliance is still placed on interviews, experience history and references—all used in connection with pre-hiring tests. Only four refineries stated that the tests had been of strictly limited value to them.

An analysis to determine whether or

not practices varied from one section of the country to another failed to reveal any significant differences among those companies which answered the survey. This is summarized in Chart 2.

Survey Results and Limitations

Before discussing the information obtained from the 21 refineries which answered the questionnaire, but do not use any pre-hiring tests, the limitations of a mail survey of this sort should be considered. In this case no attempt was made to pick a random sample from the universe, so no statistical inferences can be drawn; instead 100 percent of the refineries above a certain size (10,000 barrels daily) were covered. If the question were raised as to whether or not results obtained from analyzing the 61 responses could be extended to the 65 non-responses, the answer would have to be no. Unless some sort of additional study is made of the non-responses, there is no way of knowing what pre-hiring practices they follow.

Those personnel departments which use such tests naturally have an interest in them, and, therefore, would be more likely to answer such a survey. Conversely, personnel departments which do not use these tests would tend to be indifferent in the matter. Thus, it is quite possible that a study of the practices of the 65 non-responding refineries would reveal that very few of them have pre-hiring testing programs. However, in the absence of evidence, even a statement of this sort is conjecture.

Slightly more than half of the 21 refineries which answered in the negative checked that their present methods of selecting new employes (without tests) are satisfactory. Practically all, 19 of 21, indicated that an evaluation of the applicants' experience, history and references play an important role in their system of selection. Twenty of 21, utilize routines in which an employment office interviewer's judgment is an important factor in the hiring program.

A few of the small refineries which did not use tests stated that the union, Oil Workers International Union, CIO, was against the use of tests or "limited" the use of tests. However, a representative of the OWIU when questioned stated that the International Union had no policy opposing the use of pre-hiring tests and would not oppose such a selection program if it were operated in good faith.

Many of those companies which also place varying amounts of emphasis on the experience history and the interviewer's judgment indicated they feel that all these selection techniques must be used together in order to have a satisfactory hiring program.

"Satisfactory Hiring Program"

The concept of "a satisfactory hiring program" is an elusive one. Naturally a satisfactory program at one refinery would not necessarily be acceptable at another. However, even beyond possible differences of this sort, it is difficult to find a universally accepted criterion upon which to evaluate hiring practices. This becomes apparent when one considers the manner in which pre-hiring tests are supposed to operate.

In general, the idea is to measure with tests the characteristics of those employes who succeed and of those who are not so good on the job, and then to pick future employes with capacities like the best. This involves several assumptions: 1) that it is possible to evaluate an employe's success on the job; 2) that the ability which is deemed important has a range broad enough to exhibit measurable differences and 3) that it is possible to construct a test that will measure the ability in question. The process of correlating test scores with success on the job is known as validation.

Even the process of determining what constitutes success on the job is not easy. Possible bases for measuring an employe's job proficiency might include:

1) Supervisor's rating or opinion.
2) Amount of production.
3) Quality of production.
4) Retention or separation from the job in terms of proficiency.
5) A combination of the above.

It is obvious that a refinery can neither study the validity of pre-hiring tests if they are used nor pass judgment on the success or failure of its entire hiring program until appropriate criteria have been established.[5]

Many companies in the petroleum industry seem to define successful employes in terms of retention, not on the job alone, but as members of the working force over a long period of time. Numerous refinery managements encourage their people to make careers with the company. The non-transferable nature of pension seniority and other company sponsored insurance programs is directly in line with this policy. In this connection, at least one personnel executive, high in the management of a major oil corporation, has stated that his company is already experimenting with pre-hiring tests in an attempt to find ways to predict whether or not job applicants have the proper qualities to become career employes with that company.

Conclusion

The whole problem of the use of pre-hiring tests—whether to use them or not, which types to use, which types of employes to test, the cost of the test program versus the benefits to be derived—requires extensive study for each particular industrial setting where their use is under consideration.[6] However, it is not the purpose of this article to discuss the problems connected with the use of these tests. Rather, the emphasis has been on reporting their use in the petroleum refining industry. Of the 126 largest refineries in the United States at least 40 use pre-hiring tests in some form. The very fact that these 40 refineries use this particular personnel technique indicates that it must be of value to them.

Refinery personnel managers will doubtless be interested in some sort of picture of industry-wide practices, such as this article presents. However, when decisions are pending involving the establishment of a testing program, recourse must never be made to how many refineries do or do not employ tests. Instead, the decision to adopt any test should be based wholly on whether that test is a valid index of the qualities being tested, and should take full cognizance of the particular employe situation that obtains within the individual refinery.

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Photograph of a section of a failed tube showing excessive thinning and pitting of the outer surface. Note also the circumferential cracks.

CORROSION STUDIES CAN INCREASE THE ECONOMY OF COPPER ALLOYS

Copper and its alloys are notable for their resistance to corrosion under a wide variety of conditions. There are industrial applications where copper or the appropriate copper alloy should give an indefinitely long life, but where failure because of corrosion may result by reason of unsuitable design of equipment or improper control of environment. Further, there are many situations in which no commercial metal or alloy will have an extended life, but in which copper or one of its alloys possesses a combination of physical and chemical properties which render it the best obtainable material, when all factors, including ultimate costs, are taken into consideration. Hence correct specification becomes of great importance. Recognition of this by industry is responsible for the fact that the Revere Research Department devotes so much time to studying the corrosive effects of fluids and gases, and to preventive measures.

Recently a large manufacturer, who produces condensers as well as other equipment, reported that arsenical Admiralty tubes in a steam-jet ejector were failing after five years. This length of service is not too bad, but nevertheless such tubes often last much longer. Could we make any suggestions?

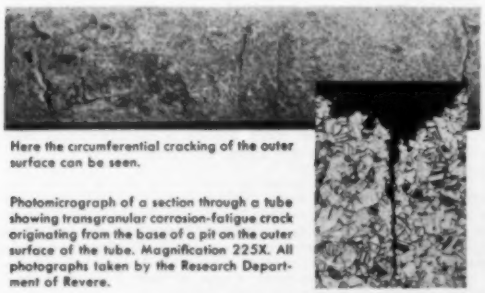
Seven failed tubes were examined for type of corrosion, metal and scale analysis. The facts were: outer surfaces were badly pitted and grooved with holes completely through in some areas; the inside surfaces were relatively untouched; cracking was circumferential, progressing from the outside; outer scale was largely cupric carbonates and copper sulfide; inner scale was calcium carbonate, cuprous oxide and some iron oxide. Microscopic examination of the cracks showed they originated in corrosion pits on the outside, progressing inward across grain boundaries, rather than along them. The transgranular path of fracture, together with other characteristics of the microstructure, definitely established the fact that the failure was of the corrosion-fatigue type. The corroding pits on the outside created stress concentration points of weakness, from which the cracks originated. Eventually the localized stress exceeded the endurance limit of the metal and it cracked.

The conclusion was, therefore, that damage was from two sources—the first being excessive carbon dioxide and the other non-condensable gases in the steam, which caused the excessive pitting and thinning. It is not unusual to have these and other corrodants present in damaging amounts in the air-ejector system, whereas they are not injurious elsewhere. The second cause of failure was excessive vibration somewhere in the unit which was responsible for the corrosion fatigue failure.

RECOMMENDATIONS. The copper-base tube alloy that generally possesses the greatest resistance to the non-condensable gases responsible for the corrosion of the Admiralty tubes is 5% aluminum bronze. Re-tubing with this was suggested. It was also recommended that steps be taken to effect a material reduction in tube vibration by placing a baffle in the steam inlet. In addition, it was pointed out that many operators find it good practice to discharge the after-condenser drain to the sewer instead of returning it to the system. By this means, the amount of carbon dioxide, ammonia and other gases in the system can be substantially decreased.

* * *

It is interesting to note that the Revere Research Department, located in Rome, N. Y., was able to determine these causes and suggest remedies without ever having seen the condenser. This is the result of modern equipment, and long experience in studying the problems of corrosion. If you have a problem regarding the corrosion of copper and copper alloys, or aluminum alloys, why not take it up with the nearest Revere office? Remember, corrosion that is too rapid wastes both your money and our national resources.



Here the circumferential cracking of the outer surface can be seen.

Photomicrograph of a section through a tube showing transgranular corrosion-fatigue crack originating from the base of a pit on the outer surface of the tube. Magnification 225X. All photographs taken by the Research Department of Revere.

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REFINER AUTHORS and Other Personalities

Information, formal and otherwise, about the men who write for PETROLEUM REFINER as well as others prominent in the processing industry.

Fred H. Poettmann

E. N. Pennington

K. H. Hachmuth

E. W. Midlam

J. D. Dorsey

Oklahoma Trio Offer Calculation Short-Cuts

The busy engineer or chemist will find the article on page 103, "Fractionation Calculations Made Easier and Faster" by Karl H. Hachmuth, Fred H. Poettmann and E. N. Pennington, a welcome addition to the literature. This trio, all residing and working in Oklahoma at present, have gained recognition not only through their engineering work, but also through their contributions to the mathematical analysis of engineering problems.

The first of the trio, Karl H. Hachmuth, was graduated from the University of Michigan with a B. S. degree in chemical engineering. He spent his first professional years working in manufactured-gas plants and as a development chemist for the Ozokerite Mining Company which mined a petroleum residue called earth-wax. He joined the Phillips Petroleum Company in 1927 as a chemical engineer, serving successively as research engineer, group leader, section chief, associate director of research, technical consultant in chemical engineering, and member of the research planning board, which position he now occupies. In addition to being an authority on chemical purification and separation of petroleum materials, Hachmuth is known for his contributions to the study of phase equilibria, to the study of thermodynamics, and to the mathematical analysis of chemical engineering problems.

Fred H. Poettmann's formal education began in 1938 at the Case Institute of Technology where he graduated with a B. S. in chemical engineering in 1942. From that year until 1946, he attended the University of Michigan where he received an M.S. and Sc.D. in chemical engineering. In January, 1946, he joined the Phillips Petroleum Company research staff where he has been engaged primarily in research on problems connected with reservoir engineering. His present position with Phillips is manager of production research. During the past four years he has been teaching graduate extension courses in the evenings in chemical engineering through the Oklahoma A. & M. Extension Service in Bartlesville. Other work experience has included positions as chemist during summer vacations for the American Gas Association and as research chemist for the Lubri Zol Corporation.

E. N. Pennington is a native of Ottawa, Kan. He graduated from junior college at Southwest Baptist College in 1938 and the following three years were spent working for Hall Brothers, Inc., in Kansas City. Then came a four-year stretch in the Army. In 1948, he received a B.S. in chemical engineering from Carnegie Institute of Technology and joined Phillips immediately after graduation. His primary interests there have been in separation processes. His work has included research, pilot plant development, and calculation studies including the development of calculation methods. At present he is engaged in making economic evaluation studies. Also during the past three years he had been continuing his studies at Oklahoma A. & M. where he received an M. S. degree in chemical engineering this spring.

Hobbies Wait While Engineer-Authors Write

Edward W. Midlam and J. D. Dorsey probably heaved several wishful sighs during the writing of "Cit-Con Whips Lube Plant Instrumentation Problems" on page 137, for both men like to get outdoors for their relaxation. Midlam, a native of Wilmington, Del., and Lehigh University graduate, likes to spend off hours on the golf course, while Dorsey, head of the Cit-Con Instrument Department, roams the bayous of southwestern Louisiana hunting and fishing at every opportunity. However, it's evident that their wishful thinking did not hurt the quality of the piece. Midlam, who also collects coins as a hobby, worked for Socony-Vacuum in the research department for nearly three years after his graduation from Lehigh. He then joined Max B. Miller & Company, Inc., where he remained until the company was dissolved in 1950. He joined Cit-Con that year as a process engineer and in 1951 was promoted to his present position of Director of Technical Services.

Dorsey was employed by various refinery and construction firms in the United States and South America from 1936 to 1939. He joined the instrument department staff at the Baytown refinery of Humble Oil & Refining Company in 1939. In 1942 he was employed as instrument department supervisor at Maumelle Ordnance in his hometown, Little Rock, Ark. He transferred to the Lake Charles refinery of Cities Service Refining Corporation in 1943, and later became head of the instrument department of the butadiene plant at Lake Charles. In 1949, he transferred to his present position as head of the instrument department.

Froemke Teaches When Not Going to School

R. L. Froemke, author of "Should Refineries Use Pre-Employment Tests?" on page 156 is a college professor who's going to school himself this summer. In his own words, "Presently I am alternating between a job as an Assistant Professor at the College of Business Administration at the University of Georgia, and a doctoral candidate working for a Ph.D. in industrial engineering at Columbia University. At the moment, I am in New York to attend

PETROLEUM CHEMICALS DIVISION
NEWS

July ★ One of a Series of Interest to the Petroleum Industry ★ 1952

Du Pont Celebrates 150th Anniversary

Six thousand Du Pont employees with 10 years of service or more will attend the company's 150th Anniversary ceremonies on July 18th at the site of the original powder mills along the historic Brandywine at Wilmington, Delaware.

Dramatic episodes in the company's history will be enacted on this occasion, augmented by the Du Pont chorus. Speakers will point out the broad philosophy of the company and the effect this philosophy had on its growth. Mr. Crawford Greenewalt, President, will speak on the future of the Du Pont Company, not in a material way, but rather in consideration of the problems of a large corporation in the coming years.

Wide Range of Movies Available to Oil Companies Through Du Pont Film Library

To help you relate your sales promotion activities as closely as possible to the individual interests of your various customer groups, Du Pont makes available to the oil companies a comprehensive assortment of films.

They cover a wide variety of subjects . . . gasoline quality, safety, automotive maintenance, farming and lubrication. There are many general interest films, too . . . on oil industry operations and economics, on research, on the free enterprise system, and even one on how color conditioning can improve working conditions and employee relations in offices and plants.

Not all of the films were produced by the Du Pont Company. Many of them were originally made by the U. S. Bureau of Mines, by oil companies and by automotive parts makers. But for your convenience, they are available through the Du Pont Film Library.

MANY USES

Several of the films are suitable for dealer training and employee education, as well as for sales promotion. And the new Du Pont movie, "Pipeline on Wheels," is specially tailored to the oil industry's public relations needs.

How can you obtain the films? Just write the nearest Du Pont Petroleum Chemicals Division district office for a brochure describing the films in detail and giving complete instructions on how to request the films you want.

"PIPELINE ON WHEELS" Movie Wins A Top Safety Award

Oil Executives Aided in Production of Film . . . Helped Make it an Outstanding Success

The Petroleum Chemicals Division of the Du Pont Company was recently advised by the National Committee on Films for Safety that it had won one of the committee's annual awards for the motion picture, "Pipeline on Wheels."

BEHIND THE SCENES—"Pipeline on Wheels" was produced on location by professional Hollywood directors, actors, cameramen and sound and light specialists.

What's Your Standing Among Competitive Octane Ratings?

You'll find the answer to this important question in the July issue of Du Pont's Quarterly Motor Gasoline Survey.

The results of this survey are scheduled to roll off the presses in the middle of July so that copies will be in refiners' hands during the week of July 21st.

This edition should be of particular interest to refiners and marketers — especially since the TEL shortage has been alleviated and government restrictions lifted.

The film was selected as a co-winner of top honors in the non-theatrical general classification for movies produced during 1951. It was chosen on the basis of its contribution to safety as well as for technical excellence.

OIL MEN CONTRIBUTE

Although "Pipeline on Wheels" was produced by Du Pont for the oil industry, many oil men contributed to its success. In preparing the script, Du Pont consulted over a hundred representatives of the API and NPA, executives of individual oil companies, automotive engineers and safety officials. Their enthusiastic cooperation brought forth many suggestions and ideas which were incorporated in the film. As a result, the film is accurate and authoritative.

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED

Movie Award

PUBLIC RELATIONS VALUE

The main objective of this full-color sound movie is to help oil companies overcome some of the prejudice against operating tank trucks on public highways. Produced in Hollywood, the film is specially designed to show the public how tank trucks are built to incorporate every possible safety feature . . . and how the oil companies train their drivers for safe highway operation. It also emphasizes the fact that gasoline tank trucks are vitally important to our modern motorized civilization.

By presenting a case for the tank truck, it is a valuable public relations tool for the oil industry. As such, it is suitable for oil company showings to municipal authorities, safety groups, civic organizations, state highway officials and legislative groups.

All demonstrations shown in the picture are authentic and filmed under the actual conditions described in the script. One of the dramatic highlights of the movie, for example, occurs when an ultra-hot gas-jet fire is built under a tank truck trailer loaded with gasoline. This demonstration provides *convincing proof* that the modern tank truck can be subjected to a severe fire without exploding.

The film delivers its message in the form of an entertaining human interest story. And besides filling a definite need in public education, the film is an ideal aid for training tank truck drivers and maintenance crews.

AN OIL INDUSTRY EXCLUSIVE

Shortly after "Pipeline on Wheels" was released for showings, the demand for its use exceeded all expectations. Originally, since the movie was produced for the exclusive use of the oil industry, 50 prints were made up. But, as requests for the film came into the Du Pont district offices, it soon became apparent that this quantity was not enough. Today, there are 175 prints in circulation among oil companies throughout the country.

What's more, requests for prints poured in from insurance companies, fire departments, trucking firms and many other interested groups. But, because of Du Pont's policy to distribute the film exclusively through oil companies, all of these requests from non-oil organizations were channeled to the oil companies—to enable them to take full advantage of the public relations value of the film.

NEW HEAD OF EXPORT SECTION

WALTER MEES

Holland-born Walter Mees heads up the petroleum chemicals sales section of Du Pont's Organic Chemicals Department. Mr. Mees' appointment to this position some months ago was part of a substantial expansion of the Company's export organization handling such petroleum chemicals as tetraethyl lead, gasoline dyes and antioxidants, Metal Deactivator, grease stabilizers, lube oil additives and cetane.

After graduating from a commercial and technical college in Holland, Mr. Mees entered business in Canada and abroad. In 1929 he joined the Royal Dutch Shell Group and passed through all phases of the oil industry from drilling to marketing.

In 1935 he entered another field, but returned to Shell in 1945 and until 1949 served as General Management Assistant with the Shell Caribbean Petroleum Company in Venezuela. Mr. Mees joined Du Pont in May 1950 and since that time has worked exclusively with petroleum chemicals products.

New Du Pont TEL Storage and Tank Truck Terminal Being Completed on Pacific Coast

Within a few months, Du Pont's new tetraethyl lead storage terminal at El Monte, California will be functioning full blast on behalf of the oil industry in Southern California.

The terminal, complete with railroad sidings for receipt of tank car shipments; and with weigh tank and storage facilities, will make all deliveries via Du Pont-owned tank trucks.

One purpose of this is to make TEL more conveniently available to those refiners who previously had to receive "lead" in drums due to lack of railroad sidings.

The terminal will also help insure an immediate emergency supply of tetraethyl lead to refiners whose regular shipments may have been held up by local floods, or other delays *en route*. And large refiners who for any reason whatsoever may be in need of rush shipments smaller than in R. R. tank car lots can also benefit by the new tank truck delivery system.

Further, to expedite the handling and delivery of TEL, Du Pont-designed Metal-Flex hose installations are used in both the loading and unloading operations at the terminal.

LITERATURE AVAILABLE

Here is a partial listing of the bulletins, reports, booklets and aids available to you through your Du Pont Petroleum Chemicals Division district office:

Safety for the Small Refinery — A 42-page book on how to set up an effective small refinery safety program . . . . . Serial A-2848

Tank Talk — A 52-page, easy-to-understand safety booklet for tank-cleaning crews . . . . . Serial A-1134

Stability of Present-Day Gasolines — A 12-page paper on the value of storage tests—as compared with induction period—for determining stability of modern gasolines . Serial A-3199

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A-3663

Printed in U. S. A.

R. L. Froemke | R. C. Alden | Elizabeth Aldrich | J. F. Elder | E. D. Verink

summer school at Columbia."

Froemke was reared and went to school in Denver, Colo., entering the Colorado School of Mines in 1939 and graduating in 1943 with the degree of petroleum engineer. Immediately following, he entered the Navy as an Ensign and spent most of the war at various naval bases doing marine engineering work, such as helping on the construction of the battleship Missouri. He was in the occupation force which took over the Japanese naval base at Yokosuka, Japan, at the end of hostilities. He was discharged as a lieutenant in 1946. Once out of the service, Froemke headed back to school. This time it was Georgia Institute of Technology where he received a Master of Science degree in 1948, majoring in industrial management.

He next worked for one year as a chemical engineer at the refinery operated by the Magnolia Petroleum Company at Beaumont, Texas, before winding up in his present job. He is married and has four children, two boys and a like number of girls.

Woman Gets Her Say in Fuel Volatility Piece

Elizabeth W. Aldrich teamed up with R. C. Alden and H. J. Elder to turn out the article "Trend In Motor Fuel Volatility Is Still Upward" on page 115, but having technical papers published is nothing new to her. She has co-authored numerous papers concerned with gasoline volatility, principally on the subject of vapor lock. From 1928 to 1946, she was employed in the Automotive Powerplant and Lubrication and Liquid Fuels Sections of the National Bureau of Standards. During this period she was engaged in studies of the characteristics of gasolines and lubricating oils in relation to various performance problems. Since 1946, she has continued work in this and related fields in the Research Division of Phillips Petroleum Company.

R. C. Alden, director of the research department at Phillips, started his career back in 1918 when he graduated from Lehigh University and went into the Signal Corps as a Second Lieutenant. Following the war, he was in the steel industry for a while, then moved over into the petroleum field. In 1921, he entered research work as a chemist for Chestnut & Smith Corporation in Oklahoma and Texas. In 1925, he joined the research staff at Phillips as a senior chemist. In 1930, he was made assistant director of research and in 1933 director of research. In his work with Phillips he has had an active part in that company's pioneering developments, including intensive studies of a wide variety of processes for the conversion of gaseous hydrocarbons to liquid fuels.

H. J. Elder is a native of Bartlesville, graduating from his hometown school, Oklahoma A&M, in 1943 with a B.S. degree in mechanical engineering. Since that time he has been in the Research Division of Phillips Petroleum Company, working on development and evaluation of aviation and motor fuels. His background in the field of fuel evaluation includes laboratory detonation studies, equilibrium air distillation testing and correlation, road testing and various studies of fuel volatility as related to performance problems.

Corrosion Authority Takes Look At Aluminum

Ellis D. Verink, Jr., author of the top-drawer piece on page 141, "Have You Tried Aluminum in Your Refinery?" came into this world in Peking, China, but returned to the States in time to go through the public schools of Missouri, Iowa, and Indiana. From high school, he went to Purdue University where he graduated in 1941 with a bachelor of science degree in metallurgical engineering.

He served from 1941 until 1946 in the United States Navy and held a commission as Lieutenant Commander at the time of his release from active service. He joined Aluminum Company of America's Development Division in 1946 and not long after became head of the chemical section, which assignment he holds today.

An authority on corrosion and an expert on the solution of industrial corrosion problems, he is a member of the American Institute of Chemical Engineers and the National Association of Corrosion Engineers. Verink is married and has one child.

B. H. Farrier | T. S. Keaty

Years of Experience Behind Esso Authors

With more than half a century of working with Esso Standard Oil Company employes between them, Bennett H. Farrier and Tom S. Keaty, collaborators behind "Retirement Like Graduation—Many New Opportunities Beckon" on page 69, know whereof they speak. Holding a slight edge over his co-author, Bennett H. Farrier's 30 years of working with employes on retirement and other company programs has made him one of the recognized authorities in the oil industry on employe benefit programs. A proud father of two sons one of whom was recently commissioned as a lieutenant in the Air Force, he is active in civic work, with much of his spare time going into the Baton Rouge refinery's employe's medical association. He is secretary-treasurer of the organization which furnishes a complete family medical plan, operated by 6000 employes of the refinery. He is the official head of Esso's Baton Rouge Annuities and Benefits Department.

Tom S. Keaty is supervisor of Employe Training at the Baton Rouge plant. He has been an Esso man since graduation from Louisiana State University in 1928 with a B. S. degree in chemical engineering. His 24 years of Esso jobs have included engineering assignments in research, instrumentation, safety, sales and now training. Married, with four children, his hobby is aviation and, as a Major in the Civil Air Patrol, commands the Louisiana Wing Group No. 1 A pioneer in oil industry training, Keaty is past president of the American Society of Training Directors.

The MONTH... in the INDUSTRY

GETS NATIONAL PRIZE—Joseph Kiczek (left center) is shown here receiving the national prize for Tide Water Associated Oil Company's employe suggestions. V. I. Graves, vice president, (right center) is handing him the $1000 check. Edward Daley of the suggestion committee is on the extreme left and H. S. Chase, company vice president on the right. See item below.

50-Million-Barrel Products Loss Attributed To Strike

An estimated 50 million barrels of oil products production was lost during the recent oil industry strikes, Dr. Robert E. Wilson, Standard Oil Company (Indiana) board chairman said recently.

Speaking before a meeting of the purchasing and stores division of the Association of American Railroads, Wilson added:

"This means the country has suddenly gone from an excess of around 10 million barrels of products to a deficiency of around 40 million barrels, nearly half of which is in gasoline."

Gasoline losses were estimated at "somewhat over 20 million barrels" and kerosine and distillate losses as "around 12 million barrels."

Price controls will make it difficult to take care of scarcities, because they have "largely destroyed the automatic regulatory effect of price on supply and demand, both as between different areas and different products," he warned.

Wilson said the higher prices would bring into operation the refineries that can't operate profitably under present ceiling prices, which have "remained practicaly unchanged over the past 17 months in spite of much higher labor and other costs."

Rise In Oil Output Needed To Make Up Strike Losses

New Deputy Administrator for the Petroleum Administration for Defense, J. Ed Warren, has said the nation's refiners must operate at 93 percent of capacity between now and the end of next March to recover the oil production lost by strikes in May.

Speaking before the Pennsylvania Grade Crude Oil Association, he said because of refinery shutdowns, 65 million barrels of potential petroleum products output was lost.

"If this quantity is to be replaced so the products will be available for the next winter season, refinery runs must increase 200,000 barrels per day.

"If refinery output is not stepped up, "he warned, "we will be in a bad way." He said this was particularly true of the East Coast, where a shortage of house heating and residual oils "already casts a shadow across all predictions."

New York AIChE Announces New Officers for 1952-53

The New York section of the American Institute of Chemical Engineers has announced the election of new officers for the 1952-53 season. The following men were named to office: Howard L. Malakoff, chairman; Frank B. White, vice chairman; C. J. Brown, secretary; Max Strawn, treasurer, and Richard F. Shaffer, counselor-at-large.

Corrosion Talk Delivered By International Nickel Engineer

F. L. La Que, engineer in charge corrosion engineering section, International Nickel Company, Inc., discussed "Velocity Effects in Corrosion" before the Petroleum, Chemical and Process Industries Group of the Hydraulic Institute at a meeting recently in Sea Island, Ga. The talk covered results of experiments by International Nickel Company at their Harbor Laboratory near Wilmington, N. C., on the rate of corrosion in relation to velocity and its effects on various metals.

Ashland Chairman P. G. Blazer Presented Honorary Law Degree

Paul G. Blazer, chairman of the board of Ashland Oil & Refining Company, was the recipient of an honorary Doctor of Laws degree at the University of Kentucky's 85th annual commencement in Lexington, Ky., recently. This is the second honor conferred on Blazer by the University. He received the Sullivan Medallion as outstanding Kentucky citizen in 1948.

Sinclair Promotes Martin, Flowers To Research Posts

W. M. Flowers has been promoted to the presidency of Sinclair Research Laboratories, Inc., and E. J. Martin has been named vice president and general manager of Sinclair's Harvey Research Center.

Martin

Educated at the University of Illinois, Flowers joined the Sinclair Refining Company in the cracking division of their research and development department in 1928. Since 1930 his activities have primarily concerned petroleum economics. In 1950, he left his post as director of Sinclair's Economic Analysis Division to accept a promotion in the company's New York office. He was named executive vice president for the Research Laboratories in May of last year.

Martin joined the Sinclair staff in 1929.

Tide Water Employe Wins $1600 Award For Suggestion

Joseph Kiczek received $1000 recently at first prize in Tide Water Associated Oil Company's nation-wide suggestion plan conducted among its employes during 1951. Kiczek, who is a work group leader at Tide Water's Bayonne refinery, had already been awarded $100 for his suggestion as best among the refinery workers and $550 as best in the company's eastern division comprising 13 states.

His suggestion concerned the simplifying of a maintenance operation in a lubricating oil solvent refining unit.

Second national prize of $750 went to C. W. Smith, of the company's drilling department in California, whose suggestion had already won $600 in western division prizes.

A suggestion by I. A. Studley, of Tide Water's Avon, Calif., refinery, earned the $600 third national award plus $500 in local and divisional prizes.

The presentation (accompanying photo) to Kiczek was made by B. I. Graves, vice president, director and chairman of the eastern division operating committee.

Defense Need Cited For U. S. Synthetic Fuel Development

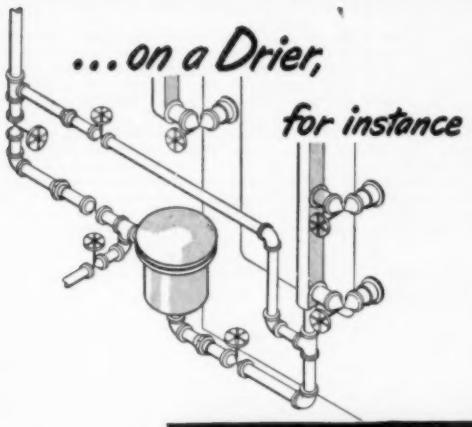
National security considerations should outweigh economic factors when considering the need for immediate development of synthetic liquid fuels, an Interior Department spokesman said recently. Taking part in a coal-to-oil symposium before the Rocky Mountain Coal Mining Institute, Defense Solid Fuels Administrator Charles W. Conner declared that, should all-out war break, vulnerability of our foreign oil sources and overseas supply lines would pose a serious threat to our potential military power.

In light of these considerations, he added, "I believe that the need is clearly demonstrated for the rapid development of a position of preparedness with respect to the production of liquid fuels from coal."

RESA Chapter Installed At Texaco Beacon Laboratories

A new chapter of RESA, the Scientific Research Society of America, has been formally established at the Beacon Laboratories, the main research center of The Texas Company, at Beacon, N. Y. Organized two years ago as The

Example of Steam Trap Durability



THE INSTALLATION

On heavy-duty, steam-heated tumbler-type drier at American Linen Supply Company, Cincinnati.

THE HISTORY

A high discharge capacity trap was needed to operate this drier 16 hours daily under heavy loads, with 125 psi. steam. Specifications called for rapid, fully automatic condensate removal to insure fast warm-ups and a steady flow of hot, dry steam to the drier. Naturally, the lowest possible trap maintenance cost was also wanted.

The choice was a Crane 150-Pound Inverted Open Float Steam Trap, carefully selected for adequate drainage capacity, and above all, properly installed.

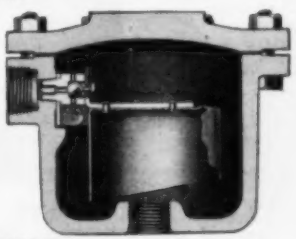
In service more than 8 years and never needing any repairs or new parts, the Crane trap has given complete satisfaction. Total maintenance expense: periodic routine inspection only.

TRAP SERVICE RATINGS

SERVICE LIFE:	More than 8 years - Heavy duty
SUITABILITY:	High discharge capacity
MAINTENANCE COST:	None - Routine inspection only
SPECIAL FEATURES:	Simple, dependable mechanism
OPERATING RESULTS:	Fast warm-ups - Steady even heat
PRICE:	Good Buy
AVAILABILITY:	Stock item in Crane line

THE TRAP

Crane Iron Body Inverted Open Float Steam Trap, for 1 to 300 pounds saturated steam working pressures. Small and compact in all sizes, yet has high discharge capacity. Patented ball-type seating gives positive pressure seal. Simple operating mechanism with only one moving unit assures durable, trouble-free performance. See your Crane Catalog or your Crane Representative for complete data on these highly efficient traps.



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The Month...

Texaco Research Club, the chapter recently received its charter from Dr. Karl T. Compton at an installation dinner addressed by Rear Admiral Luis de Florez. The Texaco chapter is the fifth to be granted to an industrial laboratory.

Blair Named Superintendent Of New Texas Plastic Plant

Dr. C. M. Blair has been named superintendent of the new chemicals and plastic resins plant to be constructed at Seadrift, Texas, by the Carbide and Carbon Chemicals Company, a division of Union Carbide and Carbon Corporation. Blair is a native Texan and attended the University of Texas from which he received his Ph.D degree in organic chemistry in 1933. His initial work with Carbide and Carbon Chemical Company began in the research laboratory at South Charleston, W. Va., in 1934. When Carbide began operations at the Texas City, Texas, plant in 1941, he moved there as assistant superintendent in charge of chemical manufacturing and the technical development laboratory.

Harley M. Ross, superintendent of Carbide and Carbon Chemicals' Texas City plant, has been appointed assistant works manager for the company. Ross, who has been at Texas City since 1941, will take over his duties in New York.

Administrative Assistant Named by Indiana Standard

Harold M. Madsen has been appointed administrative assistant to the general manager of manufacturing of Standard Oil Company (Indiana), an additional position, at the general offices in Chicago. His assignment will include study of organization plans, policies, methods, and procedures. He was formerly supervisor in the training section of the industrial relations division at the company's Whiting, Ind., refinery. Madsen joined Standard in 1928 at its Whiting refinery, where he has since worked in the engineering, projects and industrial relations divisions. He served in the corps of engineers during World War II. He received a mechanical engineering degree from the University of Illinois and was also graduated from the University of Chicago School of Business.

Stone & Webster President Receives Honorary Degree

An honorary degree of Doctor of Engineering was conferred on Russell T. Branch, president of Stone & Webster Engineering Corporation, by Stevens Institute of Technology recently on the 40th anniversary of his graduation from that institution. In conferring the degree upon Branch, Dr. Jess Harrison Davis, president of the Institute said, "He typifies the engineer who has distinguished himself through the combined use of his technical and administrative abilities."

Branch

NEW LUBE CLASSIFICATION—Officers of the API's Lubrication Committee discuss results of the three-day Tulsa conference which featured discussion of the new API Service Classifications for Motor Oils. Left to right are G. T. Dougherty (Standard Oil Company of Indiana), vice-chairman of the committee; R. Cubicciotti (L. Sonneborn Sons, Inc.), secretary; W. M. Murray (Deep Rock Oil), chairman of the program committee, and B. G. Symon (Shell Oil Company), committee chairman.

The big business of the three-day session of the API Lubrication Committee meeting in Tulsa, May 26-28, was the launching of an industry-wide education program to explain the use of new motor oil classifications recently announced by the group. The new classifications were the work of a special API panel headed by G. A. Round, working in conjunction with a special study group of the American Society for Testing Materials, under the chairmanship of C. G. A. Rosen. The work of the two committees resulted in the replacement of the terms "regular," "premium" and "heavy duty," with five service classifications designated by letters.

Sunray Oil Announces New Manufacturing Department

A new manufacturing, pipe line and sales department for Sunray Oil Corporation, to combine the activities of the formerly separate refining and gas-gasoline departments, has been announced.

H. W. Manley, Sunray vice president, will be in charge of the company's manufacturing, pipe lines and sales department. A technical service section will be set up under the direction of L. G. Rodgers, who formerly was general superintendent of the development and plant operations section. R. L. Riggs will be assistant to Rodgers and manager of the refining section of this technical service.

R. L. Johnson, manager of the company's refinery organization at Sunray, Okla., has also been named general manager of Sunray's refineries in Oklahoma. R. C. Underwood is superintendent of the Duncan plant, and T. L. Tiernan, manager of the Allen refinery. R. W. Griffith, formerly assistant general superintendent of development and plant operations, will become manager of gas-gasoline plants. J. R. Ellis, formerly manager of pipe line facilities in Oklahoma, has been named manager of Sunray's pipe lines and terminals.

R. B. Killingsworth Appointed Technical Head of Vacuum-Oil

The appointment of Dr. R. B. Killingsworth as manager of the technical department of Vacuum Oil Company, Ltd., London, has been announced by Socony-Vacuum Oil Company, Inc. He has been staff assistant, in charge of special products, to William M. Holaday, director of Socony-Vacuum's laboratories.

Killingsworth will be responsibe for all Vacuum technical activities. His initial assignment will be to assist in enlarging the existing technical organization to serve the British company's operations. Killingsworth joined Socony-Vacuum in 1937.

Fourth ISA Preconference Clinic Set For Sept. 5, 6, 7

The Fourth Preconference ISA Instrument Maintenance Clinic will be operated during September 5, 6, and 7, the three days prior to the opening of the Seventh National Instrument Conference and Exhibit to be held in Cleveland, Ohio, September 8 through 12. The clinic program will include classes on thermal elements, electrical measuring circuits, pressure elements and primary flow elements, electrical deflection and indicators, total quantity meters, electronics positioning devices, pneumatic positioning devices and final control elements. Classes will be held at Case Institute of Technology.

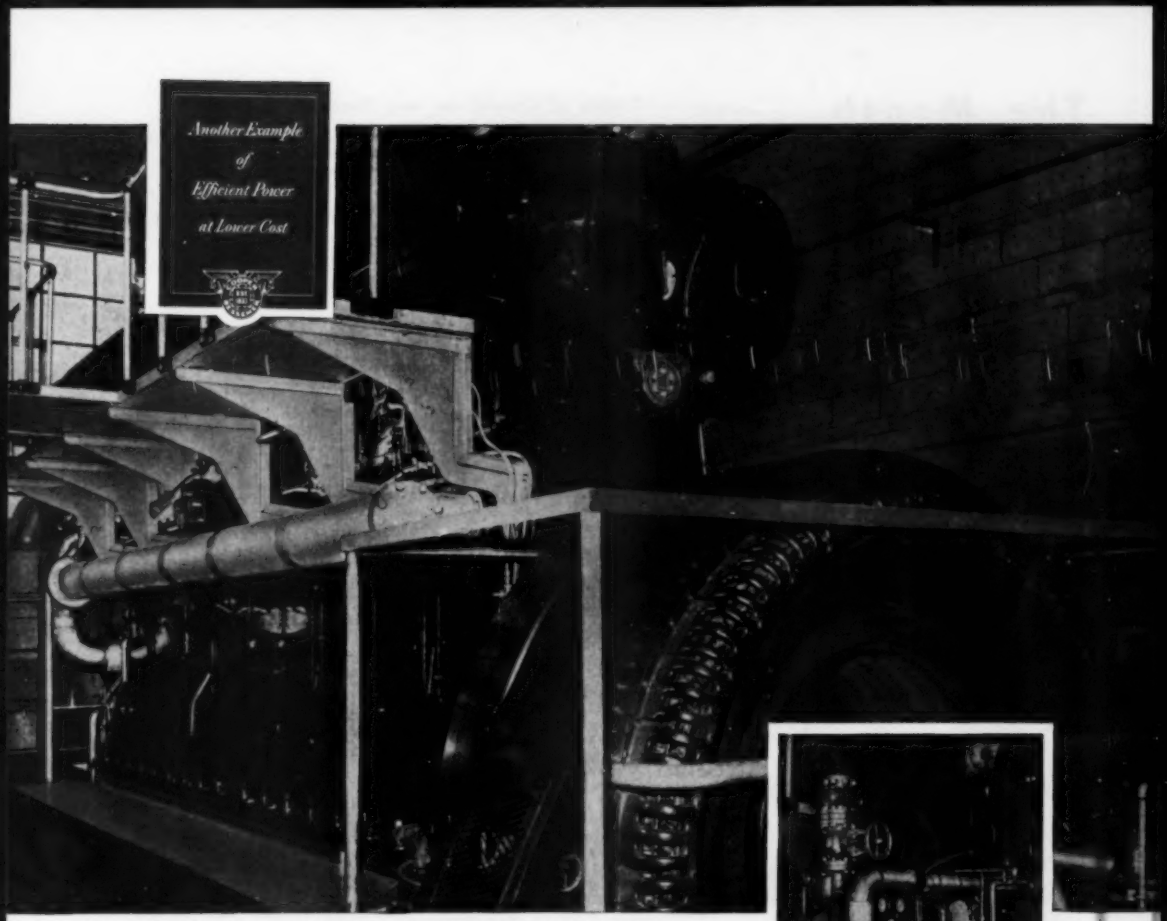
Also Dr. Axel H. Peterson, chairman of the Analysis Instrumentation Committee of the ISA, has announced that plans are now completed for a new clinic to be held in conjunction with the Instrument Conference. This clinic will consist of a lecture and demonstration course on complex analytical instruments. Electronic, optical and mechanical design features will be covered as well as details of application.

W. H. T. Furry Added To Staff Of Foxboro Training School

Now in its 17th year of providing facilities in industrial instrument engineering, The Foxboro Company has announced the addition of W. H. T. Furry to its training school staff as an associate director. Furry, formerly training co-ordinator at the Atlantic Refining Company, has taught courses in instrumentation for Pennsylvania State College and the Philadelphia section of the Instrument Society of America. The school provides a variety of training programs in process measurement and control.

New Manager, Assistant Named By Atlantic At Philadelphia

The appointment of D. T. Shaw as manager of the Philadelphia refinery and John S. Patchin as assistant manager



Latest of three Cooper-Bessemer LS-8 diesels in International Latex plant, this supercharged 1700 hp unit provides 40% thermal efficiency. End view at right shows piping setup for jacket water heat recovery contributing to 80% over-all thermal efficiency.

How they stretch dollars at International Latex

● Here's a diesel plant that is turning in amazing results—*80% over-all thermal efficiency!* The engine is a Cooper-Bessemer supercharged LS-8, installed in the International Latex plant at Playtex Park, Dover, Delaware.

To start with, this modern LS diesel exceeds 40% thermal efficiency—performance rarely equalled! On top of that, an ingenious jacket water heat recovery system captures for processing use another 40% of the total heat input.

In all there are three Cooper-Bessemer LS-8's in this International Latex plant—the supercharged unit shown above and two previously installed atmospheric LS-8's. Later on these original LS-8's can be easily converted to supercharged operation to boost their output and to match the remarkable efficiency of the new unit.

Whatever your power needs may be, check with Cooper-Bessemer. Find out how much you stand to save by the best to be had in efficiency and long, trouble-free engine life.

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The Month...

has been announced by The Atlantic Refining Company. Shaw joined Atlantic in 1929 in the research and development department and moved to the refinery in 1937, where he served as assistant manager since 1945.

Patchin has been superintendent of the refinery's mechanical department since 1950, and has served in various supervisory capacities since he joined the company in 1920.

Four Employes Transferred Overseas By Socony-Vacuum

In overseas expansion moves by Socony-Vacuum Oil Company, four men

Godwin

Fuller

Ezell

Perkins

from Magnolia Petroleum Company's Beaumont refinery are being temporarily transferred to Coryton, England, to help put a new 20,000-barrel-per-day refinery on stream.

The transferees, J. B. Godwin, H. T. Fuller, Harold Ezell and J. E. Perkins, all have long service at the Magnolia plant. They will form an operating team in starting up the Engish refinery and training personnel to take over after a two-year breaking in period.

The Coryton plant, located about 20 miles from London, is currently under construction.

Godwin, process superintendent at the Beaumont refinery, will act as plant superintendent at Coryton. Fuller will be assistant refinery superintendent; Ezell, assistant foreman of the Beaumont lube plant, takes over in England as operating foreman for petroleum light ends.

Death Claims C. W. Shropshire In Aruba, Northwest Indies

C. W. Shropshire died recently in Aruba, Northwest Indies, where he was engaged as an engineer for Lago Oil & Transport Company. Funeral services were held in All Saints Episcopal Church, Los Angeles. He was survived by his widow, Janet S. Shropshire and two sons.

Trends of Operations and Changes in Stocks

Figures on crude stocks are from Bureau of Mines weekly reports; all others from American Petroleum Institute weekly reports, which are estimates on Bureau of Mines basis.

(All figures in thousands of barrels—add 000)

Trends in Week Ended	Crude Oil: Production Daily	Crude Oil: Runs to Stills Daily	Crude Oil: Stocks Week End	Gasoline: Production Weekly	Gasoline: Stocks Week End	Gasoil and Distillate: Production Weekly	Gasoil and Distillate: Stocks Week End	Residual Fuel: Production Weekly	Residual Fuel: Stocks Week End
1951:									
January 27	6,066	6,483	244,230	21,106	134,628	9,954	63,324	9,905	41,327
February 24	5,954	6,524	237,204	20,815	145,824	10,545	52,590	9,471	39,881
March 31	6,041	6,381	235,956	20,398	150,691	9,365	46,032	9,147	38,578
April 28	6,154	6,236	242,479	19,876	145,987	8,061	47,852	8,747	36,991
May 26	6,163	6,430	246,400	21,102	139,863	8,580	55,120	9,045	38,092
June 30	6,181	6,595	247,299	21,666	136,355	8,542	70,001	9,036	42,046
July 28	6,205	6,396	251,203	21,539	130,518	8,174	81,662	8,858	45,887
August 25	6,220	6,500	252,257	21,592	125,590	8,761	91,692	8,763	47,906
September 29	6,303	6,558	255,519	21,085	122,468	9,124	104,170	8,332	49,014
October 27	6,340	6,461	259,852	22,364	121,059	9,380	109,085	8,433	50,412
November 24	6,232	6,757	260,465	22,181	122,105	9,428	105,693	9,305	48,704
December 29	6,204	6,763	256,437	22,478	133,070	10,522	89,744	9,371	43,751
1952:									
January 26	6,194	6,384	253,186	21,649	143,621	10,391	71,922	9,222	39,957
February 23	6,366	6,599	255,184	21,528	150,900	10,552	59,573	9,024	38,484
March 29	6,402	6,590	256,661	21,837	158,816	9,712	48,537	8,846	36,565
April 26	6,371	6,600	264,781	20,903	155,367	9,256	51,274	9,034	38,526
May 31	6,080	5,573	288,026	17,751	121,494	7,578	50,966	7,851	38,523
June 28	6,153	6,949	287,645*	22,772	120,902	10,066	64,143	8,987	44,972

* June 21 Stocks.

Petroleum Industry Awards $83,820 in Research-Grants

The petroleum industry has awarded a total of $83,820 in research-grant commitments and 1952-53 fellowships and scholarships at the University of Texas.

Among companies participating are the following:

Phillips Petroleum Company has sent a grant-in-aid to the Chemical Engineering Department for a fellowship, student assistants and equipment to study chemical engineering aspects of pressure-volume-temperature relationships of hydrocarbons.

Firms renewing chemical engineering fellowships are Ethyl Corporation, Gulf Oil Corporation, Humble Oil & Refining Company and The Texas Company. Standard Oil of California has established a new fellowship plus fees.

In the Chemistry Department, three companies have renewed fellowships: Pan American Refining Corporation, Humble and Magnolia Petroleum Company. The research and grant commitments range from $500 to $2800.

F. S. Blackall Nominated For ASME President's Office

The nomination of Frederick S. Blackall, Jr., president and treasurer of the Taft-Peirce Manufacturing Company, as 1953 president of The American Society of Mechanical Engineers has been announced by the society. Blackall heads a slate of new ASME nominees, including four regional vice presidents and two directors-at-large, submitted by the society's nominating committee. Since only one name is presented for each office, nomination is tantamount to election.

REPRINTS AVAILABLE

Reprints of James A. Davies' article, "Bubble Trays—Design and Layout," which appeared in the August and September, 1950, issues of PETROLEUM REFINER are available again at 50 cents each.

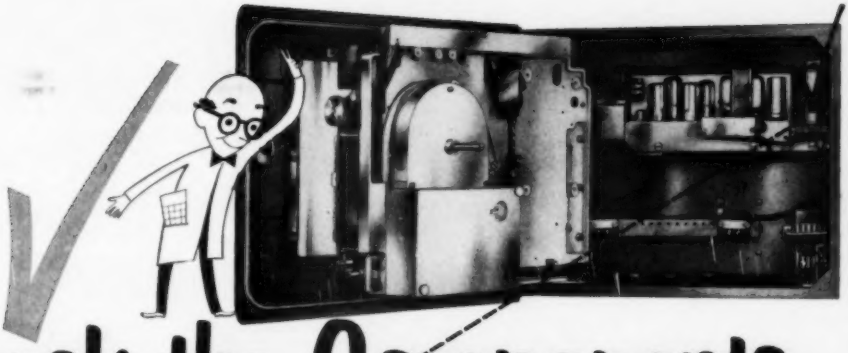
Orders or inquiries should be addressed to Librarian, Gulf Publishing Company, P. O. Box 2608, Houston 1, Texas.

THE OIL MAN'S CALENDAR

AUG. 7–9	Western Petroleum Refiners Asso., Regional Meeting, Hotel Book-Cadillac, Detroit, Mich.
25–27	Twelfth Annual Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.
SEPT. 5–6	Fourth Pre-Conference ISA Instrument Maintenance Clinic, Cleveland, Ohio, Case Institute of Technology.
8–12	ISA Conference and Exhibit, Cleveland, Cleveland Auditorium.
10–12	National Petroleum Assn., Annual, Atlantic City, The Traymore.
11–13	American Institute of Chemical Engineers, Palmer House, Chicago.
14–19	ACS, National (Petroleum Division), Atlantic City, The Traymore Hotel.
25–26	Western Petroleum Refiners Assn., Regional Meeting, Hotel Henning, Casper, Wyo.
OCT. 1–3	South Central Region, National Assn. Corrosion Engineers, New Orleans, La., Jung Hotel.
6	Independent Natural Gas Association of America, Annual Meeting, Fontenelle Hotel, Omaha, Neb.
9–10	California Natural Gasoline Assn., Annual, Los Angeles, The Ambassador.
13–15	Texas Mid-Continent Oil and Gas Association, Thirty-Third Annual Meeting, Hotel Texas, Ft. Worth, Texas.
16–17	Western Petroleum Refiners Asso., Regional Meeting, Garrett Hotel, El Dorado, Ark.
19	National Gasoline Association of America, Southern Regional Meeting, The Blackstone Hotel, Tyler, Texas.
20–24	National Safety Council, National Safety Congress and Exposition, Chicago, Conrad Hilton Hotel.
20–21	Independent Petroleum Asso. of America, Annual Meeting, Mayo Hotel, Tulsa, Okla.
Wk. of Oct. 27	AGA Annual, Atlantic City, Auditorium.
NOV. 8–13	Oil Industry Information Committee, Conrad Hilton Hotel, Chicago.
10–13	API Annual, Chicago, Conrad Hilton Hotel and Palmer House.
DEC. 7	Natural Gasoline Asso. of America, Panhandle-Plains Regional Meeting, Herring Hotel, Amarillo, Texas.
7–10	AIChE, Annual, Cleveland, Hotels Cleveland and Carter.

Blaw-Knox Names Montgomery

Chemical Plants division of Blaw-Knox Company has named G. W. Montgomery to head the design, general en-



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The Dynamaster is a superior recording and controlling instrument because every component part is superior.

Take the Syncroverter* Switch; pictured above.

This vibrator-type d-c to a-c converter incorporates so many unique improvements that many scientists, laboratories, and manufacturers are using it in their own devices.

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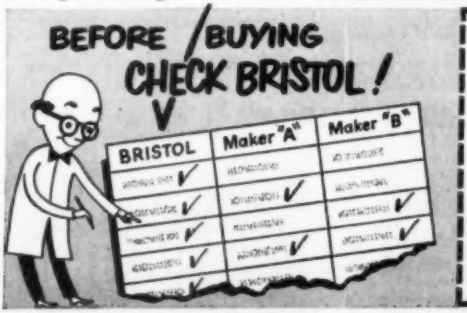

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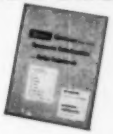

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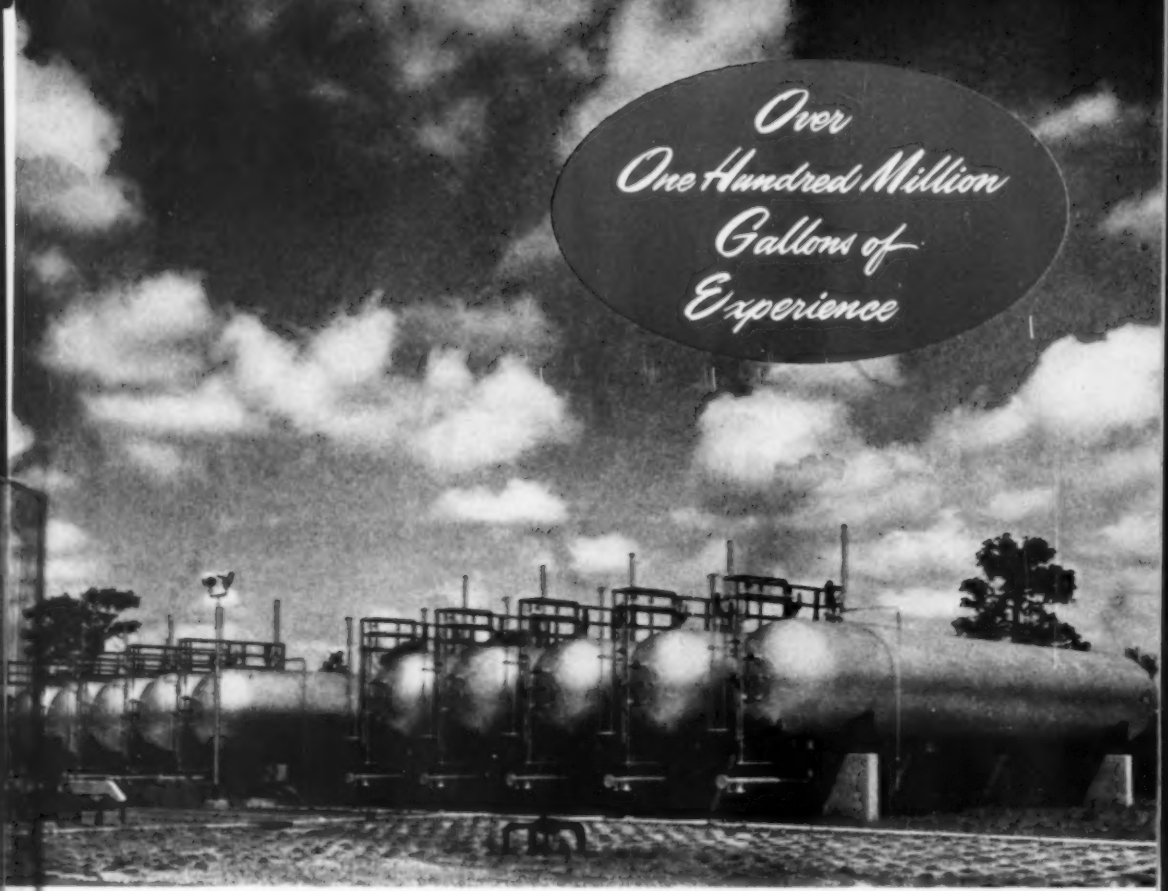

A bank of ten Beaird-Built pressure storage tanks in a South Louisiana gasoline plant.

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THE EXPERIENCE of designing and fabricating over one hundred million gallons of pressure storage equipment goes into the Beaird tanks you receive today. For thirty-four years Beaird-Built pressure vessels have been in use by petroleum and chemical industries throughout the nation.

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gineering department of the Southwest Headquarters. A graduate civil engineer, Montgomery has been with Blaw-Knox Chemical Plants division since 1944.

Continental Names Baker Research, Development Head

E. R. Baker has been promoted to manager of Continental Oil Company's development and research department with headquarters in Ponca City, Okla. He succeeds L. L. Davis, who is retiring after 25 years of service with the company. Davis, who has been development and research manager since 1948, will continue to serve the company in a consulting capacity.

Baker

Davis

Baker joined Continental at Ponca City in 1948 as manager of the central research laboratories and became assistant manager of the development and research department last year.

Stanvac Names Marshall, Schlereth In Promotions

Standard-Vacuum Oil Company has announced the election of C. B. Marshall, a director for the past three years, as one of its vice presidents and of H. I. Schlereth, formerly an assistant treasurer, to be the company's secretary. Marshall started his career as a marketer in India 32 years ago after graduation from Denison University. Following a series of sales assignments in Madras, Calcutta and Bombay, he was named general manager of the company's marketing organization for prewar India.

Schlereth, succeeds H. H. Pethick who has resumed his status as a Stanvac annuitant after a year's temporary service in this position.

Governor to Do Missionary Work for Oil Exposition

A tour of Latin American oil Countries will begin shortly for Governor Johnston Murray of Oklahoma, who will be acting as "ambassador at large" for the May 14-23, 1953 International Petroleum Exposition. The four-week tour will begin August 1 and will enable the Spanish-speaking governor to visit top officials of Cuba, Santo Domingo, Puerto Rico, Trinidad, Aruba, Curacao, Venezuela, Brazil, Uraguay, Argentina, Chile, Boliva, Peru, Ecuador, Columbia, Panama, Mexico and Costa Rica.

Latin American government and oil industry leaders will receive special engraved invitations from both Murray as governor of Oklahoma, and W. G. Skelly as president of the exposition.

Governor Murray has been made an

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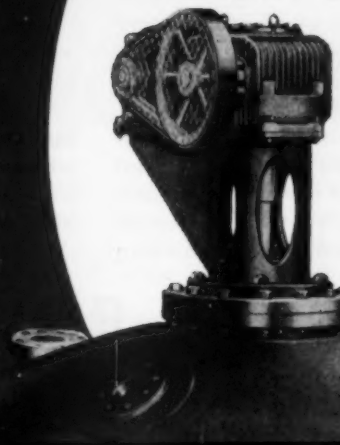

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BULLETIN Y-29 is crammed with interesting facts on how to cut down-time while clearing still tubes. Mailed on request.

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Y2-4

honorary member of the Tulsa Chapter of Nomads for the duration of his trip. The membership was conferred by Opie Dimmick, president of the Tulsa chapter.

The trip actually complements the work of the Nomads in that they have already begun to encourage their international acquaintances to attend the 1953 oil show.

As in the past, Nomads will register foreign visitors, furnish them with transportation and interpreters, and hold a banquet for them.

Forty-three nations besides the United States were represented at the last show, in 1948.

Ex-PAD Deputy Reelected Pan-Am Southern President

Bruce K. Brown, deputy administrator of the Petroleum Administration

Duty

Casey

for Defense for the past 19 months, has been re-elected a director and president of Pan-Am Southern Corporation. Roy J. Diwoky, executive vice president who served as administrative head of the company during Brown's absence, will continue to hold the executive vice president position. Diwoky will be in charge of all operating departments of the company including exploration, production and pipe line; manufacturing; supply and transportation; marketing; purchasing, and economics.

Diwoky's two assistants have been given new positions in a rearrangement of organizational assignments. Sam H. Casey, formerly assistant to the executive vice president, has been assigned to the newly created position of general manager of purchases, and Lyle R. Duty, who was also an assistant to the executive vice president, has been assigned the new position of administrative assistant to the president.

Standardization Group Draws Up Petroleum Work Program

A group of 32 petroleum experts from 11 nations, meeting for the first time in committee session, has announced that it has drawn up and agreed on an initial program of work for developing a system of international standards for measurements and testing of petroleum and petroleum products. The committee adopted as its scope of work "methods of measurement, methods of sampling, methods of test, nomenclature, terminology, and specifications for petroleum and petroleum products."

As a program for immediate future work, the committee agreed to study oil measurement tables, now under de-

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WEDGEPLUG is the ideal valve for general refinery use. For quick action, positive, trouble-free operation, ease of adjustment, and low maintenance cost, it can't be beat. A Wedgeplug Valve may be opened or closed with a few turns of the handwheel. Wedgeplug Cam action is certain, and the operator is always in control of the line. Wedgeplug does away with the problem of the "stuck valve". Protection against *any* erosion or corrosion of the vital Raised Seating Surfaces is provided both in the open and closed positions . . . The Free Stem Plug Connections allow complete seating of the Plug. Alloy steel stems of heavy cross-section eliminate any possibility of distortion. And, the Stem Pointer provides positive control of the 90 degree throw . . . Large Port Openings assure minimum restrictional loss, even at low pressures.

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Installed at the base of bulk storage tanks, these heaters bring oil to the proper temperature for easy pumping. They heat the oil only as it is withdrawn, thus reducing radiation losses to a minimum. U-bend heating element and sheath are designed for easy installation into the storage tank by welding, riveting or bolting. Heavy gauge tubes welded to tube sheet assure long equipment life.

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These heaters, built in four standard sizes, are maintained in stock at all times for prompt delivery. Heater incorporates straight tube bundle with tube sheet welded to shell, minimizing the number of joints. Type V-1 is designed for economy, simplicity, and ease of cleaning. No line connections need be broken to enter the tube circuit.

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Special Whitlock expansion member compensates for differential expansion or contraction between shell and tubes. Standard sizes are designed for working pressures of 250 psi. on both shell and tube side, but can be supplied for higher oil or steam pressures when required. Straight tubes facilitate cleaning.

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The Month...

velopment jointly by the American Society for Testing Materials in the U. S. and by the Institute of Petroleum in the United Kingdom. As a second item of immediate future work, the committee listed methods for determining the knock test of motor fuels by the so-called motor and research methods. A third item of work is terminology relative to petroleum products. The committee called for development of French and English equivalents for terms in the two languages to be supplemented later by parallel undertakings providing for the development of these terms in the languages of the other interested countries.

Staff Promotions Announced By Gas Technology Institute

The executive committee of the board of trustees of the Institute of Gas Technology has confirmed the appointments of Director E. S. Pettyjohn as vice president, Dr. J. D. Parent as dean, and of Henry R. Linden and C. G. von Fredersdorff as assistant research directors.

Pettyjohn

The naming of Pettyjohn as vice president, the first in the history of the Institute (whose president is, ex officio, the president of Illinois Institute of Technology), was done "in recognition of his contribution, as director, to the Institute's rise to its present eminent position in the fields of research and education." He is the author of numerous articles on various phases of the gas industry, the result of his participation in research for many years.

John Dean Named To So-Vac Foreign Trade Department

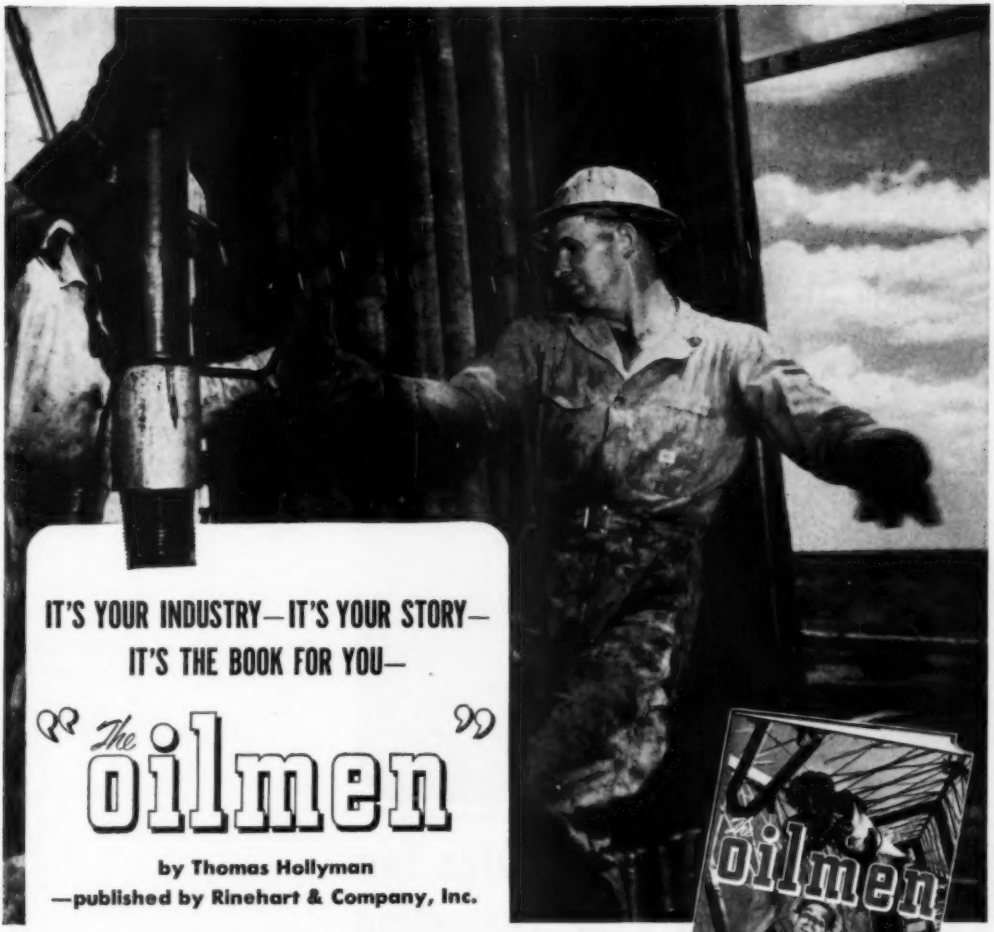
John C. Dean, manager of the industrial division, lubricating department, of Socony-Vacuum Oil Company, Inc., has been named Foreign Trade department staff advisor responsible for lubricating and allied products.

Gilbert C. Kellersman, manager of the industrial district of Socony-Vacuum's Lubrite division, succeeds Dean, while Robert D. Cross, manager of the company's southeastern industrial district, will replace Kellersman at the Lubrite division.

H. Fiske Tarbox will assist Dean, particularly in connection with overseas marketing, and W. S. Delafield will remain responsible for the coordination of supply requirements of foreign markets.

W. R. Riggs Named Manager Of Sinclair General Services

The promotion of W. R. Riggs to manager in charge of general services has been announced by Sinclair Research Laboratories, Inc. Riggs, who joined the Sinclair organization in 1932, is a chemical engineering graduate of Missouri School of Mines. His career with Sinclair has involved assignments



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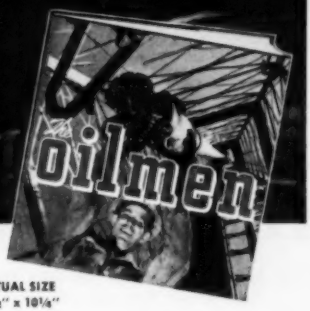

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in various divisions, including the Lube Research, Engineering, and later as Director of Pilot Plant Division. He is a member of the American Institute of Chemical Engineers, American Chemical Society, and the Harvey Area Industrial Relations Council.

Kellogg Names Paul Swanson Head Of Process Engineering

Paul F. Swanson has been named manager of the process engineering organization of The Kellogg Company. Swanson will be in charge of his firm's staff of process engineers.

Swanson

Swanson came to Kellogg 25 years ago, immediately upon his graduation as a chemical engineer from the University of Kansas. He was prominent in the development of the first continuous catalytic cracking process utilizing the Fluid catalyst principle. Most recently he has been engaged in the development of Fluid Hydroforming. Swanson will make his headquarters in Kellogg's New York office.

Foster N. Mabee Elected New President Of LPG Association

Foster N. Mabee, president of the Colorado Natural Gas & Fuel Company, was elected president of the Liquefied Petroleum Gas Association at the Association's annual convention and trade show held in Chicago recently. He succeeds W. S. Lander of the Suburban Rulane Gas Company.

Other officers named include C. M. Ambrose, Jr., Liquefied Gas Corporation, first vice president; Frank T. Carpenter, United Petroleum Gas Company, second vice president; Walter H. Miller, Dri-Gas Corporation, treasurer, and Arthur C. Kreutzer, secretary and assistant treasurer. Howard D. White continues as executive vice president and Kreutzer as association vice president and counsel.

Butterworth, Cogan Promoted By Standard Oil of Indiana

L. H. Butterworth has been promoted to manager of operations, cost control and personnel division of the manufacturing department of Standard Oil Company (Indiana) in the general office at Chicago. C. A. Cogan will succeed him as assistant general superintendent of the company's Casper, Wyo., refinery. Cogan has been superintendent of the projects, capital expenditures, miscellaneous contracts sections in the manufacturing department of the general office.

Butterworth joined Standard in 1937 as a chemical engineer in research.

Cyanamid Producing New Additive For Series 2 Oils

A new lubricating oil additive, Aerolube 92, has been developed by American Cyanamid Company. It combines oil anti-oxidant and bearing corrosion inhi-

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CROLOY 7—7% Cr, 0.50% Mo, 0.50-1.00% Si—For operating conditions up to 1250F where corrosion resistance is the primary requirement. Somewhat more oxidation resistant than Croloy 5.

CROLOY 9-M—9% Cr, 1% Mo—For severe operating conditions up to 1300F where high corrosion and oxidation resistance are essential as in hydrogenation processes.

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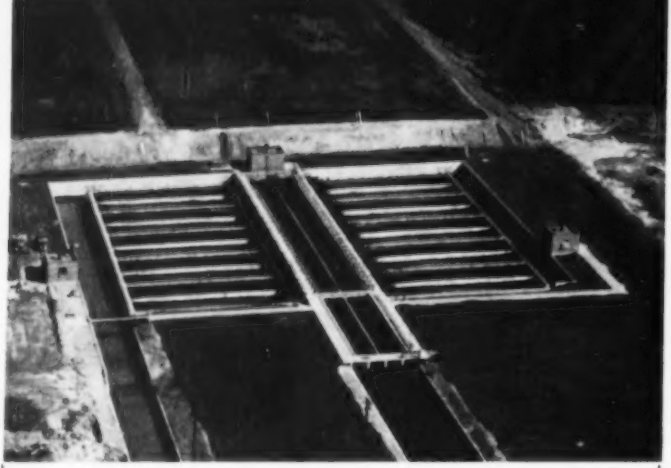

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bition properties with highly effective alkaline detergency, the company says. It was designed specifically for use in Series 2 oils which are recommended where high sulfur fuels are used or in high output supercharged equipment which is to be operated with or without high sulfur fuels.

Ohio State Honors MacLaren With Professional Degree

Frederick H. MacLaren has been honored by Ohio State University at its spring convocation by being awarded the professional degree of chemical engineer. Candidates for the professional degree are selected by the university from among its alumni "in recognition of engineering ability and accomplishments of a high order." Only four such degrees were awarded this year.

Since his graduation from Ohio State, MacLaren has been associated with the research department of Standard Oil Company (Indiana), where he is now group leader in charge of research on waxes and asphalts. His specialized field encompasses the development of quality tests for wax and asphalt products used in the paper industry.

Harold Maxwell Nominated For ASTM President's Post

Dr. Harold Lee Maxwell, supervisor of mechanical engineering consultants for E. I. du Pont de Nemours & Company has been elected to the presidency of the American Society for Testing Materials for the coming year. Simultaneously the elections of Norman L. Mochel as vice president, and George R. Gohn, William H. Lutz, Howard K. Nason, Adolph O. Schaefer and Myron A. Swayze as members of the ASTM Board of Directors were announced. Official notice of the election of these men was to be given at the society's 50th Anniversary meeting.

Foster Dee Snell Presented Institute Honor Scroll Award

The New York Chapter of the American Institute of Chemists presented its Honor Scroll Award to Dr. Foster Dee Snell at its annual meeting recently. Snell is president of Foster D. Snell, Inc.

Dr. Gustav Egloff, director of research of Universal Oil Products Company, speaking on "Foster Dee, As I Know Him" mentioned the many developments and accomplishments of Snell who started his consulting business as a part-time endeavor along with his teaching at City College of New York and Pratt Institute in the early 1920's.

Girdler Appointed Sinclair Public Relations Director

Sinclair Oil Corporation has announced the appointment of Reynolds Girdler as Director of Public Relations and Advertising for the Sinclair companies. Girdler began his career with Doremus & Company and later served as an editor of Time Magazine and financial columnist for Nation's Business. Prior to his association with Sinclair, he was for the past several years a vice president and account executive of Carl Byoir & Associates, public relations consultants.

This triple effect evaporator gives three-fold savings

General Electric Company is recording unusual economies in the amount of generating steam required to run its Pittsfield, Mass. power plant. A heavy contributor to these savings is the Lummus-designed-and-built evaporator pictured here.

This triple effect vessel really wrings maximum efficiency out of exhaust steam. Employing three effects (or stages) of evaporation—all built into one shell—the unit produces about 140 gpm of high purity distilled water, at a consumption of approximately 20,000 lb./hr. of 1.5 psig steam and 100 gpm of city water. With a sharp eye to practical aspects, Lummus designed the unit so that hot "liquor" is dumped from one effect to the other, thus minimizing heat make-up. And when the third phase is completed, all but 4 gpm of original feed water is vaporized.

The vertical, three-compartment unit is 30'6" high x 10'6" dia. Each effect contains a removable tube bundle of 956 tubes, ¾" O.D. x 9'0" long. Other components completing this all-Lummus installation are: a 1500 sq. ft. surface condenser, a feed water pre-heater, and a two-stage steam jet air ejector complete with a single inter-after condenser.

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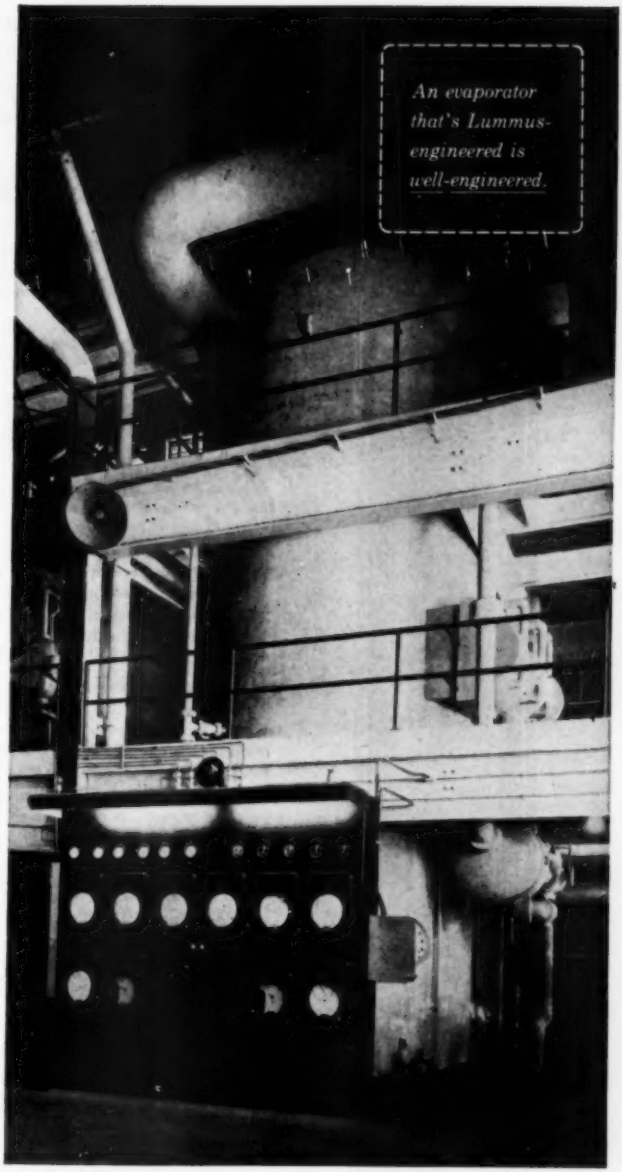

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SCIENCE and TECHNOLOGY Abstracts

Prepared by
DR. E. H. LESLIE and DR. H. B. COATS
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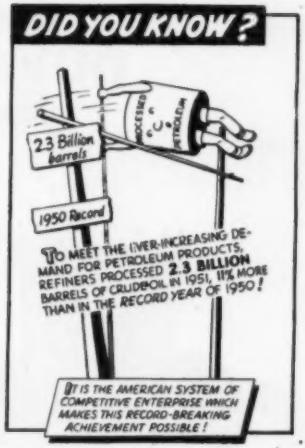
Traver Road, Ann Arbor, Mich.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Fundamental Physical and Chemical Data

Gas-liquid Equilibria of Mixtures of n-Alkanes, G. W. BEDERBRAGT AND J. J. DE ONG, *Applied Sci. Research* **A3** (1951) pp. 125-43.

The composition and equilibrium of the liquid and vapor phases was determined for hydrocarbon solutions at temperatures of 240 to 360° C. and under pressures of 10 to 60 bars. Binary mixtures were used, one component being either pentane or heptane, and the other being a hydrocarbon having 16 to 24 C atoms. The composition of the samples was determined by the loss in weight as the result of volatilization of the more volatile component. Calculated conditions of equilibrium were found to be in agreement with the observed values.

The State Diagram and the Critical Constants of Pentene, RYO KUYAMA, KEIZO SUZUKI, AND TATSUYA IKEGAMI, *Rev. Phys. Chem. Japan,* **21** (1951) pp. 50-7.

Plotting of available data on pentene indicated a critical temperature between 195° and 200° C. Accurate measurements made in a bomb gave critical constants of 197.2° and 33.7 atm.

3,4-Dithiahexane: Heat Capacity, Heats of Fusion and Vaporization, Vapor Pressure, Entropy, and Thermodynamic Functions, D. W. SCOTT, H. L. FINKE, J. P. MCCULLOUGH, M. E. GROSS, R. E. PENNINGTON AND GUY WADDINGTON, *Jour. Am. Chem. Soc.,* **74** (1952) pp. 2478-83.

The investigation reported is one in a series undertaken by this laboratory on the thermodynamic properties of the organic sulfur compounds that may be present in petroleum or that may be produced in refining processes. This paper presents the results of the work on diethyl disulfide, or 3,4-dithiahexane. The heat capacity of the solid and liquid were determined between 12 and 300° K. The triple point is 171.64° K., and the heat of fusion 2248 cal. per mole. Vapor pressure is represented by the equation $\log p_{mm} = 6.97507 - 1485.970/(t + 208.958$ heat of vaporization at 373.73 and 400.04° K. is 9780 and 9380 cal./mole respectively. The entropy of the vapor is reported and also the heat capacity of the vapor. Certain thermodynamic functions were calculated from spectroscopic and molecular-structure data for selected temperatures up to 1000° K. The authors believe that the stable form of the molecule of this substance has both ethyl groups in the trans-configuration.

Estimation of the Free Enthalpy (Gibbs free energy) of Formation of Organic Compounds from Group Contributions, D. W. VAN KREVELEN AND H. A. G. CHERMIN, *Chem. Eng. Sci.,* **1** (1951) pp. 66-80.

Free enthalpies of formation of high molecular weight molecules can be estimated by the summing of group contributions that are given as a function of temperature. Data are tabulated for convenient use in calculation for the alkanes, alkenes, conjugated alkenes, alkynes, aromatics, ring structures, branch structures, and oxygen, nitrogen, sulfur, and halogen compounds. Examples of typical calculations are presented. The average deviation was found to be ± 0.6 kcal./mol.

Viscosity-temperature Dependence, A. V. BRANCKER, *Nature,* **166** (1950) pp. 905-6.

Viscosity of a liquid varies with temperature in accordance with the simple equation $n\left[1 - \left(\frac{a}{T}\right)\right] = b$; a and b are constants and T is the absolute temperature. A plot of viscosity versus viscosity over absolute temperature gives a straight line with slope a and intercept b. In the region of the boiling point there is some deviation from the linear relationship, but not at low temperatures. At these lower temperatures the equation fits the data better than the function used for petroleum oils in the A.S.T.M. chart.

Chemical Composition and Reactions

Composition of Naphtha from Fluid Catalytic Cracking, F. W. MELPOLDER, R. A. BROWN, W. S. YOUNG, AND C. E. HEADINGTON, *Ind. Eng. Chem.,* **44** (1952) pp. 1142-6.

The results of a study of the composition of a naphtha produced by fluid catalytic cracking are presented. The sample was the total naphtha from a fluid catalytic cracking unit operating at 900° F. on synthetic silica-alumina catalyst and on a gas-oil charge stock from a mixed crude source. Yield of naphtha was 33 percent by volume of the gas-oil charge. The methods used in determining composition included infrared and ultraviolet spectroscopy, supplemented by fractional distillation, adsorption, and hydrogenation. 92 individual hydrocarbons, including 21 olefins, and 60 groups or classes of compounds were determined. Cyclopentane rings were found to outnumber cyclohexane rings by more than 3 to 1, while among the noncyclics monomethyl substitution was found to be predominant. The results are presented in considerable detail in tabular and graphical form. A bibliography of 12 references is included.

Chemical State of Vanadium in Santa Maria Valley Crude Oil, DAVIS A. SKINNER, *Ind. Eng. Chem.,* **44** (1952) pp. 1159-65.

The presence of vanadium in certain crude oils and other bituminous materials from all over the world has been known for some time. Some years ago vanadium was detected in the crude oil from the Santa Maria Valley in California. The purpose of the present work was to determine the physical and chemical state of vanadium in the crude oil and the properties of the vanadium carrier. The practical interest in the entire matter lies, of course, in the possibility of recovering substantial amounts of vanadium from crude oil. Vanadium was found to be present in the oil as a vanadium-porphyrin complex, largely in the asphaltic fraction of the crude. The stability of the complex and its water insolubility make electrical desalting operations ineffective for its removal from the oil. It appears to be destroyed when the crude is coked at about 450° C. The presence of the porphyrin complex substantiates the marine sediment origin of petroleum, and gives information concerning the history of the deposit, from which the petroleum is derived. The complex possesses stability to electrical fields and to heat treatment at 125° C. in the presence of water, but breaks down or changes its form at or below 450° C. It is not decomposed at 110° C.

THESE abstracts are selected from the current literature of science and technology, not including trade journals easily available. Photostatic copies of original articles can be obtained at nominal cost from The Library of Congress, Photoduplication Service, Washington 25, D. C. Complete or limited bibliographies covering special topics by title, by abstract, or in complete manuscript will be prepared and furnished by arrangement with The Leslie Laboratories.

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in the presence of 85 percent orthophosphoric acid. The organic nature of the material is shown by the fact of its solubility to some extent in all of the typical solvents used in the study. A bibliography of 13 references is included.

Reaction of Methyl Radicals with Hydrogen and Deuterium, Sol Davison and Milton Burton, *Jour. Am. Chem. Soc.*, **74** (1952) pp. 2307-12.

Free methyl radicals produced by photolysis of acetone or acetaldehyde in deuterium or mixtures of hydrogen and deuterium react to give various ratios of CH_4 and CH_3D depending upon competition for methyl radicals by the different compounds present. The reaction between free methyl and molecular hydrogen is $CH_3 + H_2 \rightarrow CH_4 + H$. From the results of the present work and a study of data in the literature the authors believe that the activation energy of the reaction of methyl with hydrogen is greater than 13 kcal. and the steric factor is of the order of 10^{-2}. The reaction of methyl with deuterium has an activation energy of approximately 1 kcal. greater.

The Disproportionation of Paraffins Dissolved in Isobutane Catalyzed by Aluminum Chloride and Hydrogen Chloride, Abraham Schneider, *Jour. Am. Chem. Soc.*, **74** (1952) pp. 2553-7.

It was found that normal and branched chain paraffins dissolved in an excess of isobutane underwent excessive disproportionation on treatment for one to three hours with aluminum chloride and hydrogen chloride at 100° C. The isobutane was changed to isopentane while the higher paraffins were degraded to mixtures composed largely of branched chain paraffins ranging from isopentane to those of the starting materials. Neohexane was usually formed in quantity. This type of reaction was observed with 2-methylpentane, n-hexane, n-heptane, n-octane, n-tetradecane, a Fischer-Tropsch gas-oil and a refined paraffin wax. The last three materials of high molecular weight formed products mainly in the C_5 to C_8 range, and the weight of hydrocarbon product found in each molecular weight class decreased with increasing carbon number. The author proposes a mechanism to explain this reaction.

Hydrogen Exchange Between Deuterium Oxide and Hydrocarbons on Silica-Alumina Catalyst, R. C. Hansford, P. G. Waldo, L. C. Drake, and R. E. Honig, *Ind. Eng. Chem.*, **44** (1952) pp. 1108-1113.

In a previous publication one of the authors showed that hydrocarbons undergo hydrogen exchange with water adsorbed on a typical silica-alumina cracking catalyst. The present paper considers the more quantitative aspects of the exchange reaction, and relates the mechanism of the reaction to the current generally accepted ionic theory of catalytic cracking. A deuterium-hydrogen exchange between deuterium oxide and various hydrocarbons adsorbed on a typical silica-alumina catalyst was shown to follow the basic principles of a carbonium ion mechanism. There is approximately first-order dependence on hydrocarbon concentration, which is consistent with a chain mechanism involving initiation by olefin traces and termination by hydro-

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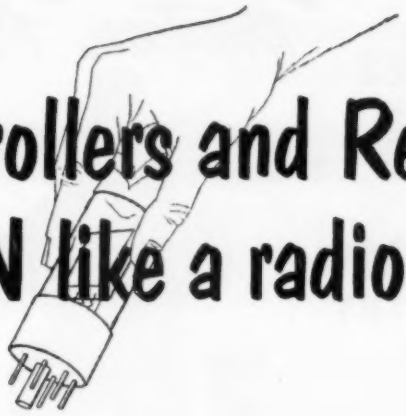

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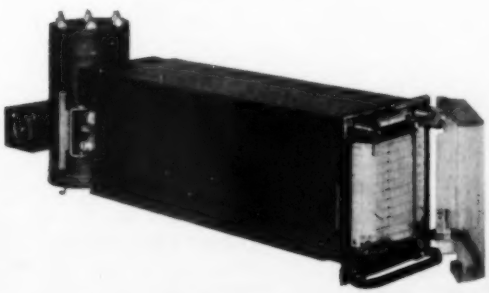

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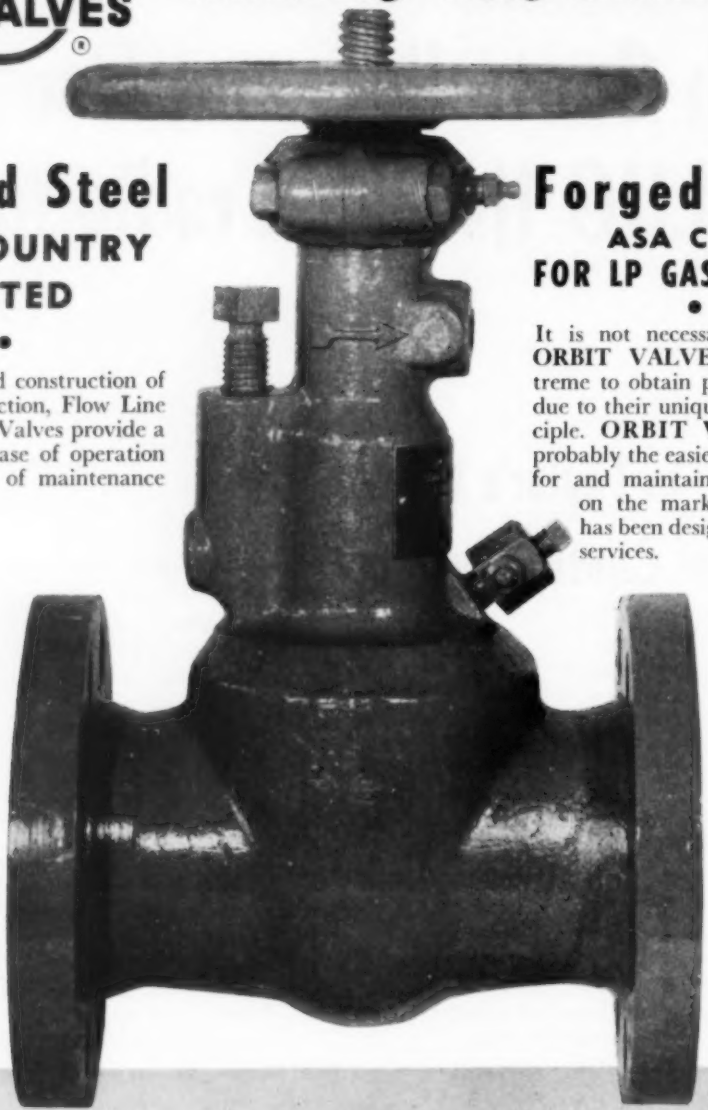

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gen transfer. The results are presented in some detail in tabular and graphical form and a bibliography of 15 references is included.

Some Catalytic Exchange and Hydrogenation Reactions of Acetylene and Ethylene, JOHN E. DOUGLAS AND B. S. RABINOVITCH, *Jour. Am. Chem. Soc.*, **74** (1952) pp. 2486-9.

The authors' experiments on the hydrogenation and exchange of acetylene and ethylene on nickel catalysts has led to the following conclusions. (1) Contrary to previously published results, exchange between ethylene molecules was found to occur. (2) The isomerization of trans-ethylene-d_2 occurs more rapidly than exchange. (3) Acetylene is adsorbed on the catalyst at least in part as a carbon complex and self-hydrogenates to give ethylene. (4) Acetylene exchanges rapidly with itself and with residual hydrogen on the catalyst. (5) When deuterium is added to acetylene at —80° C. the product is largely cis-ethylene-d_2. (6) The hydrogenation of acetylene by the one-step addition process apparently does not occur.

Manufacture: Process and Plant

Process Instrumentation, DOUGLAS M. CONSIDINE, R. E. CLARRIDGE, W. J. BERK, W. A. PATTERSON, J. M. DEVINE, F. H. TRAPNELL, J. JOHNSTON, JR., W. A. CRAWFORD, WESLEY T. DORSHEIMER, EDMUND HAIGLER, G. A. HALL, JR., *Chem. Eng.*, **59** (1952) pp. 161-208.

This is a 48-page staff report on the instrumentation of processes. It also includes a 16-page folded chart of instrument elements for all types of instrumentation. Pneumatic instrumentation has now completed another spurt of progress to keep pace with the demands for ever more exacting control and to compete with electronic instrumentation, which after a dozen years of application is now a firmly established method. A new kind of automatic instrumentation is arriving, namely that for end-point analysis, which permits connecting quality criteria of the product into the control loop. The report includes a series of articles covering new tools for the process engineer, new tools for the instrument engineer, process control by end-point analysis, the economics of instrumentation, critical discussion of graphic panels, a discussion of instruments as equipment rather than as accessories, and finally, an article on push-button plants. The article concludes with a glossary explaining the terms that are commonly used in instrument work.

Thermocouple Thermal Error, JACK W. RIZIKA AND WARREN M. ROHSENOW, *Ind. Eng. Chem.*, **44** (1952) pp. 1168-71.

The authors discuss the thermal error in temperature measurements with thermocouples and present analysis of a means for estimating the thermal error in order to obtain a closer valuation of the actual temperature. A thermocouple can measure only the temperature of the actual junction, but heat can be conducted down the thermocouple wire and lost to the environment, and thus cause a junction temperature substantially dif-

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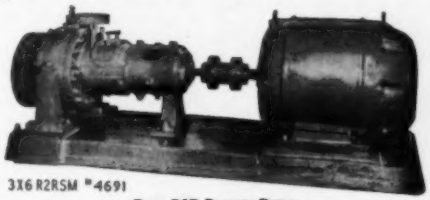

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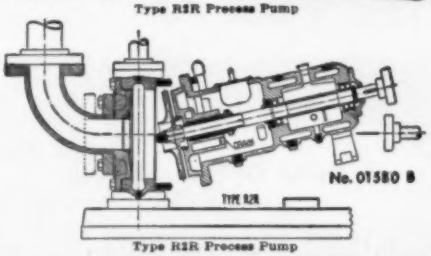

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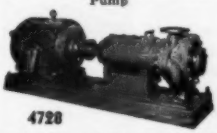

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ferent from the temperature of the fluid being measured. Charts are presented that should be useful in determining the error involved in the temperature measurement. A bibliography of 5 references is included.

Evaporation from Drops, Part II, W. E. Ranz and W. R. Marshall, Jr., *Chem. Eng. Progress,* **48** (1952) pp. 173-80.

This paper is the second part of an investigation of the factors influencing the rate of evaporation of pure liquid drops and the rate of evaporation of drops containing dissolved and suspended solids. The data, in tabular form, are completely included in the article together with additional figures, and a bibliography of 32 references.

Centrifugal Disk Atomization, S. J. Friedman, F. A. Gluckert, and W. R. Marshall, Jr., *Chem. Eng. Progress,* **48** (1952) pp. 181-91.

Three methods of atomization are commonly used in industry today, namely, pressure nozzles, two-fluid nozzles, and centrifugal disks. In spite of the wide applicability of the centrifugal disk of an atomizer, there is little reliable information on which the selection or design of disks can be based, nor is there quantitative information giving the effect of the various operating variables in their effect on the spray produced. Centrifugal disks are used in oil burners, spray dryers, and humidifying equipment. The present paper reports the results of an investigation of power consumption, drop size, drop-size distribution, and trajectory from a number of typical centrifugal disks operating over a wide range of conditions. General correlations were developed by means of which drop size and distribution from spray disks, as well as power consumed by the disks, can be predicted. The relationships proposed are found to be in general agreement with the data of other investigators. A bibliography of 35 references is included.

Nickel Catalysts for Hydrocarbon-Steam Reaction, M. R. Arnold, Kenton Atwood, H. M. Baugh, and H. D. Smyser, *Ind. Eng. Chem.,* **44** (1952) pp. 999-1003.

The authors report on part of a program of investigation of the properties of catalysts for the reaction of hydrocarbons with steam. The work relating to the life and activity of the catalysts was conducted in semimicro reactors. The results show that, in general, the catalysts with the higher nickel contents have higher activities. However, other factors are important in determining catalyst activity, including porosity, surface area, and physical strength. Poisoning of catalysts by sulfur is briefly discussed. However, the most common cause of permanent inactivation not associated with spalling is exposure to high temperatures. A bibliography of 12 references is included.

Benzene from Petroleum—At What Price? Roger Williams, Jr., *Chem. Eng.,* **59** (1952) pp. 157-60.

The author presents an analysis of the cost of producing benzene from petroleum through the medium of platforming, followed by extraction. Figures are presented in terms of the accounting method normally used by one of the large chemical companies. A cost of approximately 24 cents per gallon is shown and a sales price of 45 cents per gallon is suggested, giving a net return of 14.2 percent based on sales and a net return on the investment of 18.75 percent, these figures being after taxes.

Oil Gas Manufacture. William Q. Hull and W. A. Kohlhoff, *Ind. Eng. Chem.,* **44** (1952) pp. 936-48.

The article is a staff-industry cooperative report on the manufacture of gas from oil. The increased use of natural gas fuel has made necessary the use of standby facilities and generating capacity for peak-load, and for emergency fuel. Oil gas has been made continuously since 1906 at Portland and this company now has capacity to produce 54,000,000 cubic feet of oil gas daily. This gas has 570 btu per cubic foot, but gas with 1000 btu can be produced by alterations in existing equipment. The article describes the manufacture of oil gas and the treatment of the gas to produce a merchantable product. Chemical by-products are made in the course of gasification, and these account for 35 percent of the total manufacturing income. The crude by-products include lampblack, tar, and light oils. Tars yield creosotes, soft and hard pitch, road tars, and crude naphthalene. Light oils yield benzene, toluene, xylene, and solvent naphtha. The by-product plant facilities are described. Flow sheets of the various operations are presented. A bibliography

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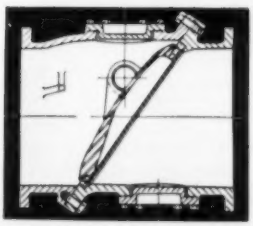

Cross-section of the Chapman Tilting-Disc Check Valve. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

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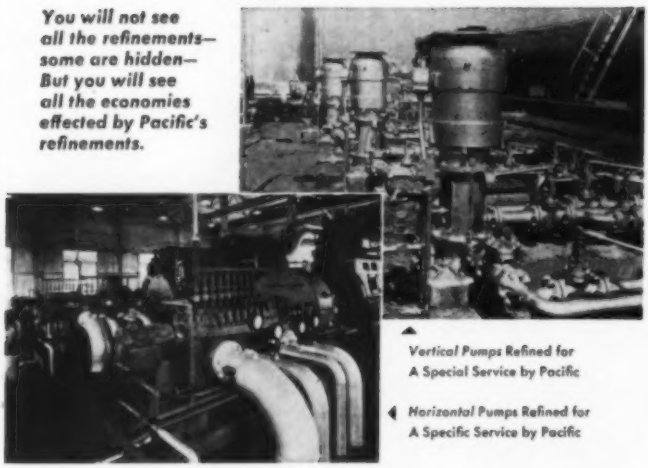

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Science and Technology

of 30 references is appended.

Gasification of Solid Fuels at Elevated Pressures, WILHELM GUMZ, *Ind. Eng. Chem.*, **44** (1952) pp. 1071-4.

The gasification of solid fuel under elevated pressure such as 20 to 30 atmospheres, offers advantages in high capacity, high fuel rates, low oxygen consumption, and decrease in cost of labor and product gas. The author feels that it may have practical application in pressurized boiler furnaces, gas turbines, and in the production of synthesis gas and high-btu fuel gas. The effect of pressure on gas composition, pressure drop in the fuel bed, and terminal velocity of suspended particles are calculated and compared with experimental data. Charts are given showing the distribution of sulfur compounds in the product gas, pressure drop in downdraft fuel beds and terminal velocities of particles of 0.01 to 10 mm. diameter. A bibliography containing 68 references is appended.

Dispersion from Short Stacks, C. A. GOSLINE, *Chem. Eng. Progress*, **48** (1952) pp. 165-72.

Although stacks are widely used for the disposal of materials to the air, the design and operation of stack disposal systems has been largely based on previous experience or rule of thumb methods. Such theoretical treatments as have existed have been largely unverified by actual tests. The author reviews three such thories. The study from which the results are reported was on a plant scale with an 80-foot stack in a fairly open area, and with a stack effluent of nitrogen oxides. The author concludes that by the selection of proper diffusion coefficients, either the Sutton or the Rosanquet relations can be applied to the solution of problems involving design of stacks for waste disposal to the atmosphere. If diffusion coefficients reported in the literature are used, the equations will predict average concentrations that agree within twofold of the actual, and improvement can be made by better selection of coefficients. A bibliography of 15 references is included.

Products: Properties, Utilization and Analysis

Alcohol as an Antiknock Agent in Automotive Engines, JAMES C. PORTER AND RICHARD WIEBE, *Ind. Eng. Chem.*, **44** (1952) pp. 1098-1104.

In order to obtain a better understanding of the effect of alcohol on hydrocarbon fuels four base stocks were selected—straight-run, catalytically cracked, thermally cracked, and polymer gasoline. The results with these base stocks and their mixtures show an excellent response to the addition of ethyl alcohol except in the case of the straight polymer gasoline. The reference fuels, such as iso-octane and n-heptane, and toluene and diisobutylene, give the highest octane gain with alcohol. Road octane numbers increased with the amount of ethyl alcohol up to 25 percent, but the relative gain was less for the highly cracked fuel than for a fuel predominantly straight run. The increases in octane number through the use of alcohol and tetraethyllead are largely independent up to 25 percent

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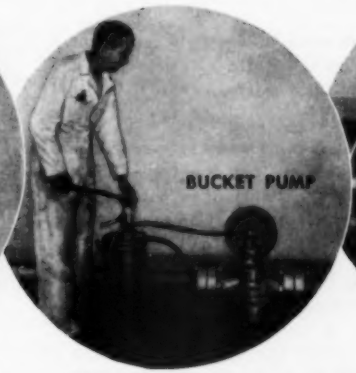

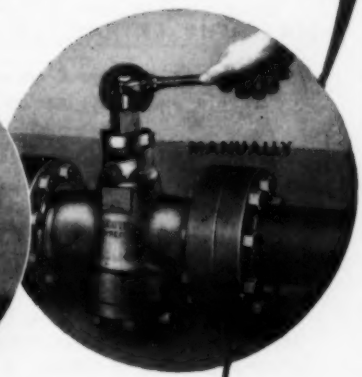

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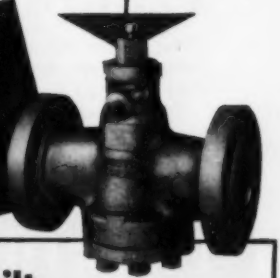

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alcohol and three ml. of tetraethyllead per gallon. The presence of tetraethyllead has no important effect on the octane blending value of alcohol with most fuels, except in highly cracked stocks. The presence of sulfur apparently does not affect the octane gain with alcohol as it does with lead. A bibliography of 18 references is included.

A Method for the Determination of the Solubility of Gases in Liquids with Particular Reference to Viscous Liquids, R. R. Baldwin and S. G. Daniel, *Jour. Applied Chem.*, **2** (1952), pp. 161-5.

The method of procedure described by the authors was developed in the course of a study of the solubility of gases in lubricating oils. The failure of fuel and oil supplies at high altitude, because of excessive gas and vapor evolution in the pump, is a serious problem and prompted the study. The method described is particularly useful with viscous liquids. The liquid, freed from gases, is saturated with the gas to be studied at a known pressure. A known volume of the saturated liquid is then flowed into an evacuated vessel and the liberated gas extracted by a Topler pump and measured. Data are given showing the accuracy obtainable for lubricating oils with a range of viscosity, and the necessary modifications for the study of normal liquids. Two pure liquids were studied, water of isooctane. The results on water agree very closely with the solubility data given in the International Critical Tables. The authors believe that even with the most viscous materials, the results are consistent to within 1 percent.

Viscosity Determination with Minimum Quantities of Oil, Walter Simmler, *Chem.-Ztg.*, **75** (1951) pp. 252-3.

Comparative viscosities of oil can be determined by measuring the rate of capillary rise in strips of ruled filter paper. An advantage of the procedure is the small quantity of oil required for the test can be run with a single drop of oil.

Determination of Hydrocarbon Functional Groups by Infrared Spectroscopy, S. H. Hastings, A. T. Watson, R. B. Williams, and J. A. Anderson, Jr., *Analytical Chem.*, **24** (1952) pp. 612-18.

The analysis for individual components in characterizing hydrocarbon solutions in the higher boiling ranges is impractical because of the tremendous number of isomeric substances present. One possible approach to analysis uses the determination of the functional groups, such as methyl and methylene, that compose the hydrocarbon molecules. The authors measured the absorptivities of a number of pure paraffin, naphthene, and aromatic hydrocarbons under carefully controlled conditions in the 3.0- to 3.5-, 6.5- to 7.5-, and 12.5- to 14.3-micron regions. These absorptivities are related to the concentrations of the various functional groups that result in the absorption—e.g., methyl and methylene groups in the paraffins at 3.38 and 3.42 microns. It is believed that this type of hydrocarbon characterization will find increasing application, particularly as more of the complex hydrocarbons become available in pure form, thus providing material for accurate calibration with a minimum of extrapolation. The equipment and procedure used in the work are described in some detail and the data are presented in graphical and tabular form. A bibliography of seven references is included.

Infrared Spectra in Identification of Derivatives of Cyclopropane, Stephen E. Wiberley and Stanley C. Bunce, *Analytical Chem.*, **24** (1952) pp. 623-5.

The presence of a cyclopropyl group in an organic molecule is difficult to establish by any chemical means. The purpose of the investigation reported by the authors was to establish more definite criteria for the identification of the cyclopropyl group by infrared spectroscopy. The infrared absorption spectra of nine cyclopropyl derivatives as obtained with a lithium fluoride prism show bands characteristic of the cyclopropyl group at 3.23 and 3.32 microns. Wave-length difference for these two bands is similar to that obtained for cyclopropane in gaseous form. The use of these two bands in conjunction with the previously reported bands at 9.9 and 10.9 to 11.7 microns gives more conclusive proof of the presence of the cyclopropyl ring system. It is believed that a further study of cyclobutyl and cyclopentyl derivatives in the carbon-hydrogen region of 3.4 microns will yield similar selective assignments for these ring systems. The data secured are presented in tabular and graphical form and a bibliography of 15 references is included.

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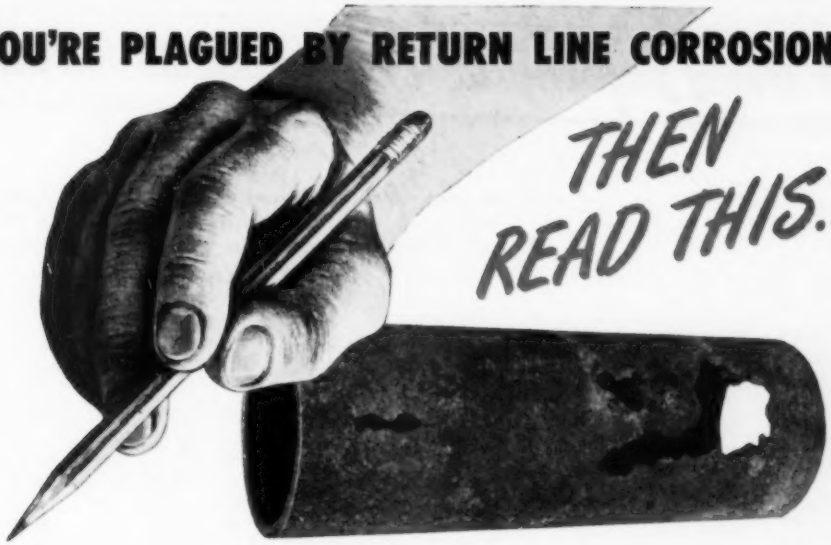

As an engineer responsible for efficient, economical plant operation, you know only too well that corrosion of steam and condensate lines can send costs skyrocketing through pipe replacement, interrupted production, and increased labor and maintenance. Perhaps you, like many other engineers, have tried stop-gap methods to check the problem only to find them partially effective or far too costly.

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New Catalogs AND EQUIPMENT LITERATURE

For copies of the catalogs and new equipment literature listed, use one of the convenient Reader Service Postcards on this page. Just Circle the number on the card corresponding to the number of the item in which you are interested.

Expansion Joints Bulletin

A bulletin describing the new Flexon line of expansion joints has been released by Flexonics Corporation. The new bulletin gives complete specification and installation data for Flexon-type Free-Flexing joints for low pressure applications. Controlled-Flexing joints for high pressure installations and Flexoniflex joints for the handling of extremely high pressures.

Circle No. 1 on Postcard

Protective Glove Catalog

A new catalog showing how to choose the right protective glove for the job, and how to get the most out of your glove dollars, has been announced by the Pioneer Rubber Company, makers of Stanzoil liquid-tight all neoprene, neoprene coated and vinyl coated industrial gloves.

Circle No. 2 on Postcard

Starter, Breaker Conduletes

Designed to house circuit breakers up to and including the 600-ampere frame size, line starters sizes 0 through 4 and combinations of these starters with circuit breakers up to 225- ampere frame size, the Type EPC Explosion-Proof Conduletes are described in a new bulletin just published by Crouse-Hinds Company. This explosion-proof equipment will control motors up to 100 horsepower at 440 or 550 volts and protect feeders up to 600 amperes at 600 volts. The bulletin gives complete specifications, dimensions and ordering information.

Circle No. 3 on Postcard

Consulting Chemist, Engineer

"The Consulting Chemist and Chemical Engineer in a World Economy," a 32-page book describing the services performed by consulting chemists and chemical engineers, has been published by the Association of Consulting Chemists and Chemical Engineers, Inc. Included are points to check when selecting a consulting engineer or chemist, and case histories where a consultant's service has paid off. The books are sold for $1 per copy.

Circle No. 4 on Postcard

Welding Preheating Booklet

A reprint of "Preheating for Welding" by Arthur B. Tesmen is being offered to persons making requests on their business stationery by Tempil® Corporation. The paper reviews welding procedures which have been found by experience to produce crack-free welding joints under a wide variety of conditions. The reprints will be supplied free of charge.

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New Catalogs AND EQUIPMENT LITERATURE

Use one of the free and convenient Reader Service Postcards on this page to request copies of the catalogs in which you are interested.

New Plasticizer Booklet

A new booklet featuring the complete line of Emery Plastolein Plasticizer has been released by Emery Industries, Inc. In addition to specifications and properties for plasticizers, it contains considerable information on testing of Plasticizers including ultra-violet stability and heat stability. Test methods and stabilizer data are also included.

Circle No. 6 on Postcard

Tachometers Data Sheet

The Metron Instrument Company has announced the availability of the Metron Technical Data Sheet No.-T4. The sheet describes the principle of operation of Metron hand, portable, and fixed installation tachometers. Literature contains simplified circuit diagrams, and descriptions of various models. The basic circuit and its advantages are described in detail.

Circle No. 7 on Postcard

Smoke Recorder Bulletin

A brief bulletin is now available on the Ess Smoke Recorder for the use of plant and combustion engineers interested in recording stack smoke density and combustion performance. Published by the manufacturer, Ess Instrument Company, Bulletin 512 contains wiring and installation diagrams.

Circle No. 8 on Postcard

Air Pressure, Vacuum Pumps

A bulletin on Eberbach air pressure or vacuum pumps designed for laboratory applications has been published by Eberbach Corporation and is available upon request. The bulletin gives complete performance and size specifications, suggested uses and illustrated descriptions of the unmounted and motor-mounted models.

Circle No. 9 on Postcard

Castable Walls Brochure

A brochure describing the one-source efficiency of Bigelow-Liptak's castable walls for catalytic vessel lining, cyclones, flue gas stacks and ducts, and catalytic-carrying lines for oil refineries has been released by the Bigelow-Liptak Corporation. Several drawings of typical installations are incuded.

Circle No. 10 on Postcard

Alarm Silencing Relay

Bulletin 8501 describes the new Honeywell Alarm Silencing Relay, used in electric control circuits. Plant operators will frequently silence audible alarms by opening a knife switch then neglect to close the switch after the condition causing the alarm has been corrected. This relay supplies the means for silencing and resetting the alarm, and contains a signal lamp which indicates that the alarm has been sounded. The Bulletin includes a wiring diagram, dimensions and installation data.

Circle No. 11 on Postcard

(More Literature Items on Pages 193, 195, 197, 199.)

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NEW EQUIPMENT and Manufacturers' Literature

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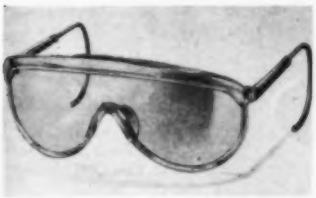
Plastic Safety Goggles



A new safety goggle, featuring a transparent plastic frame which provides a greater field of vision, has been announced by American Optical Company. The new goggle is designed and recommended for wear directly over the eyes or over spectacles. It is particularly useful for frontal protection against foreign particles on machine and hand tool work, bottling, chemical and physical laboratory work, spot welding, light grinding, light chipping and light riveting.

Circle No. 12 on Postcard

Steel Corrosion Resistance

"Corrosion Resisting Properties of the Austenitic Chromium-Nickel Stainless Steels" is the title of the latest booklet published by The International Nickel Company and available to interested persons. It is a general publication which covers the mechanism of corrosion resistance in stainless steels, factors affecting their corrosion, their behavior in various corrosive environments, marine and industrial atmosphere, in organic and inorganic acid salt solutions and in halogen salts and weak and strong bases, and the preferred practice in construction and use of stainless steels.

Circle No. 13 on Postcard

Industrial Steam Traps

W. H. Nicholson & Company's new bulletin No. 152 features steam traps equipped with bellows of bronze, monel or stainless, and bodies in bronze, semi-steel and cast steel construction in sizes ¼-inch to two inches, for all pressures from vacuum to 300 pounds. Included along with capacity tables and dimensions are recommended piping diagrams, typical applications, tables and data covering the selections of traps for various types of steam-using equipment.

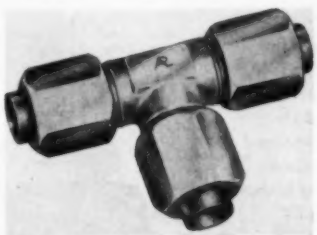
Circle No. 14 on Postcard

Safety Devices Catalog

Organized to display the various products according to function, the latest bulletin published by McDonnell & Miller, Inc., is designed primarily as a workbook to help in the selection and application of the Company's safety devices for steam and hot water boilers, and heaters. The book should be of interest to design men and consulting engineers as well as heating contractors, and others with problems involving liquid level control. Included are many specialized variations adapted for original equipment use, plus various components as they have been utilized for liquid level control applications. Capacity curves, dimension drawings and engineering information are included.

Circle No. 15 on Postcard

Industrial Aluminum Tubing



The Parker Appliance Company has announced production of a standard-stock line of aluminum tube fittings for strictly industrial applications. The line includes male and female connectors, elbows, tees, union and tube end reducer for ¼, 5/16, ⅜ and ½-inch outside tubing. This new line of aluminum fittings is provided in the Triple-lok design—the three-piece flare fitting. Tube in such alloys as B50S is readily available in long lengths, and has good workability characteristics for easy flaring and bending.

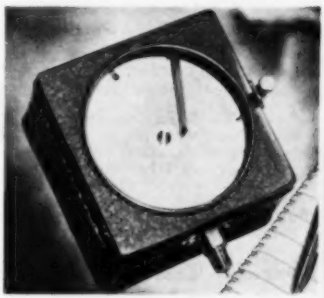
Circle No. 16 on Postcard

Laboratory Furniture Units

Labline, Inc., has published a new bulletin describing and illustrating their complete line of Labline Sectional Laboratory Furniture. Each unit is standardized to give the service and appearance of custom-built furniture. Over 17 basic metal units are described.

Circle No. 17 on Postcard

Low Pressure Recorder



An instrument designed to measure and record low pressures has been developed by The Dickson Company and is known as the Type 3-B Minicorder. It charts records as low as 0 to 10-inches head of water pressure, with other chart ranges available to as high as 0 to 60 psig. Minicorders operate on the same fundamental principle and provide the same continuous chart records as all other pressure actuated 8, 10 and 12-inch recorders, and carry the same accuracy guarantee. Describe intended use of the instrument when requesting further information.

Circle No. 18 on Postcard

Temperature Controls Data

The Burling Instrument Company has announced the publication of a new catalog, No. G-17, which describes their full line of temperature controls. Special features of this catalog are the additions of four new instruments and inclusion of tables of application and performance for all instruments. Covered also is the use of Burling controls for temperatures from minus 300° to plus 1800° F. and in various severe applications.

Circle No. 19 on Postcard

Controllable Capacity Pumps

Aldrich Pump Company's latest data sheet, 65A, describes applications, features, design and operation of Aldrich-Groff "Powr-Savr" controllable capacity pumps. The sheet includes sectional and dimensional drawings, ratings and a diagrammatic layout of the Aldrich type "A" automatic hydraulic stroke-control system for boiler feeding, oil burner supply and similar applications.

Circle No. 20 on Postcard

hot liquids

corrosives

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acids

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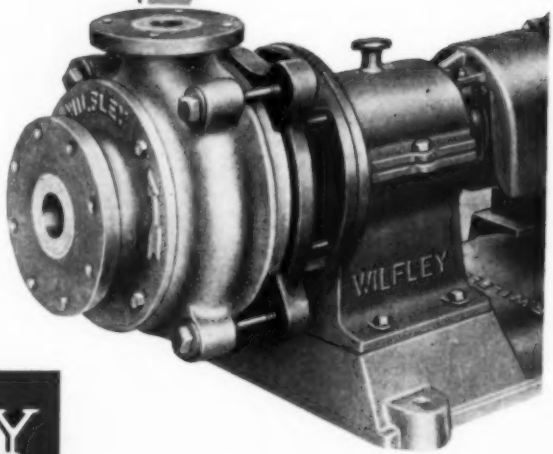
• Available in 10- to 2,000-G.P.M. capacities, 15- to 150-ft. heads and higher. Wetted parts of practically all machineable alloys. Plastic lined models available. Every application individually engineered. Write or wire for details.



WILFLEY *Acid* **PUMPS**

A. R. WILFLEY & SONS, Inc., Denver, Colorado, U.S.A.

New York Office: 1775 Broadway • New York City

Temperature Control Unit

A bulletin released by Illinois Testing Laboratories, Inc., contains information on its Almor Pyrotac, a new temperature control unit that automatically monitors up to 20 individual temperature points a minute, gives instant and accurate readings on temperature variations within any phase of heat processing. Manufacturers claim that the unit can be used in almost any operation where heat is involved. The motor-drive switch unit can be obtained separately.

Circle No. 21 on Postcard

Color-Coded Rubber Hose

Thermoid Company has announced the consolidation of its molded hose line from 18 different types into five basic types, color-coded for identification according to use. These include rayon braids of high tensile strength, instead of cotton, and new tubes and covers of both natural and synthetic rubber. Each type in the new line has a distinctive cover color, coded according to applications, which will prevent confusion in stocking and use.

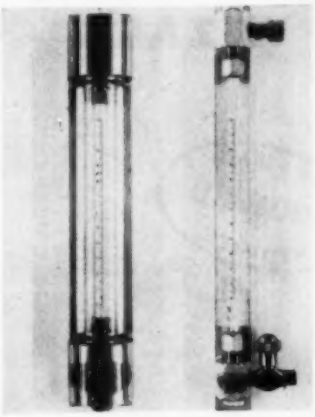
Circle No. 22 on Postcard

Spray Gun Paint Strainer

Gardner Laboratory, Inc., has announced the addition of the Midget Paint Strainer, pictured above, and the Rein Paint Strainer to its line of products. The Midget strainer fits on the suction tube on all popular commercial spray guns having a 7/16-inch diameter tube. No pre-straining is necessary since the Midget strains the material as it leaves the spray gun. The strainer can be cleaned in the same operation that cleans the gun. The Rein strainer has an aluminum-coated steel wire stand that supports an aluminum funnel in which a copper-mesh strainer is held in place by a steel wire loop. It is rust resistant, and the suppliers claim that given proper care will last for many years.

Circle No. 23 on Postcard

Micro Flowmeter Series



Designed for the accurate metering of small volumes of liquids and gases in laboratory and pilot plant operations, a new line of micro flowmeters has been developed by the Technical Equipment Company. Both high pressure (1000 psig) and the low pressure (100 psig) models have maximum flow rates of 6-105 ml/min for water and 90-610 ml/min for air at 20° C. Four sizes of tubes and four float compositions are stocked. Both models employ a rotating float in a tapered glass tube. An exclusive ionizing anti-static device is available for factory installation on tubes metering gases. Descriptive literature is available.

Circle No. 24 on Postcard

Controlled Volume Pumps

The Milton Roy Company has announced a new bulletin, No. 351, covering the company's line of air-operated pumps and systems. Complete details of construction, operation and application are included. Air consumption and capacity-pressure tables are included for pumps handling from 0.4 to 405 gph against discharge pressures up to 21,000 psi.

Circle No. 25 on Postcard

High Discharge Relief Valve

The A. W. Cash Valve Manufacturing Corporation has published a new bulletin, No. 290, describing a completely new safety relief valve, Cash Acme's Type F 51. This valve is claimed to have the highest discharge rate of any safety relief valve on the market of comparable size. The bulletin is self-explanatory in describing the new product and shipment of the Type F 51 valve.

Circle No. 26 on Postcard

Air-Operated Motor Valves

The Honeywell Series 700 Double-Seated Diaphragm Valve is fully described in a new Specification Sheet 400-4 issued by the Minneapolis-Honeywell Regulator Company. The new sheet gives pertinent data such as sizes, construction, trim materials, temperature, pressure ratings for various body materials, pressure drops and complete mounting dimensions. Also described are the various types of discs available and some of the major design advantages.

Circle No. 27 on Postcard

Heat Transfer Apparatus

The Griscom-Russell Company has released a picture-book presentation of some of their designs of heaters, coolers, condensers and heat exchangers for all types of liquids, vapors and gases. The material in the bulletin is arranged in sections to show some of the various types of G-R apparatus which are of interest to the oil and gas industry. The equipment and representative installations are accompanied by a brief explanation of design features and application.

Circle No. 28 on Postcard

Stainless Steel Booklet

The Allegheny Ludlum Steel Corporation is publishing a series of booklets dealing with the uses of stainless steel in the various industries. Latest in the series, is one dealing with the petroleum industry. Contents include chapters on stainless steel in the crude, refining, natural gasoline, transportation and marketing. A discussion on the technology, fabrication and available forms of the material is also featured.

Circle No. 29 on Postcard

Magnetic Driving Devices

A new magnetic adapter and magnetic hexagon-square shank have been developed for use only with Williams Impact "Supersockets" to drive hex head hardened and self-tapping screws by J. H. Williams & Company. A telescopic magnetic device passes within an assembled socket and contacts the screw head, retaining the head with the socket opening. The Alnico magnet, imbedded in the drive member, is spring loaded to overcome air gaps and transmits its magnetism through a hardened stell tip to the head of the screw.

Circle No. 30 on Postcard

The ingenious, simply-designed mechanism of Fisher Wizard Controllers provides extreme accuracy and dependability in pressure control.

Fisher Wizard Controllers will completely solve your pressure control problems. They are individually built to meet your exact operating conditions, and are guaranteed to give satisfactory performance.

High pressure Fisher Wizards are available in throttling and snap acting types. Bourdon Tube pressures from 5 to 10,000 P.S.I. Diaphragm or remote panel mounting.

Low pressure Fisher Wizards available in diaphragm or remote panel mounting. Bellows pressures from ½ to 15 P.S.I.

FISHER LEADS THE INDUSTRY IN RESEARCH
FOR BETTER PRESSURE CONTROL

FISHER GOVERNOR COMPANY Marshalltown, Iowa

Automatic Fire Extinguisher

Grinnell Company's new ProtectoSpray fights fires at the molecular level by diluting the active ingredients of flame. The heat from a fire normally raises the temperature of nearby flammable material to its distillation and ignition temperatures. The automatic ProtectoSpray diverts this heat to vaporized water droplets. This removal of heat checks the spread of fire and the resulting water vapor dilutes the flame gases so that they cannot burn. Producing a wide range of water droplet sizes, small ones to produce water vapor and larger ones to wet and cool the burning material, the ProtectoSpray is approved by both the Factory Mutual Laboratories and the Underwriters Laboratories.

Circle No. 31 on Postcard

Zeolite Water Softening

Cochrane Corporation has issued a revised edition of their bulletin on Sodium Zeolite Softeners, known as Publication 4520-A which gives a detailed explanation of zeolite water softening, including a glossary of terms used in the process, data for laying out a zeolite softening plant, the factors governing the size of equipment, the selection of zeolite materials and a detailed description of the four stages of operation of a sodium zeolite softener. A complete description of the Cochrane Hydromatic Single Control Valve is included.

Circle No. 32 on Postcard

Dual Temperature Insulation

Dual temperature pipe insulation, a new scientifically designed Fiberglas insulation for pipe lines operating at low temperatures or at alternate cycles of high and low temperatures, is now being offered by Owens-Corning Fiberglas Corporation. This insulation is made of fibrous glass bonded with a thermosetting binder and is preformed in hemicylinders and segments that fit all standard pipe and tubing sizes. A vapor barrier, composed of laminations of asphalted draft paper and aluminum foil adhered to the Fiberglas insulation with a bituminous adhesive, provides condensation control on cold lines passing through warmer temperatures. When used as a vapor barrier the dual temperature insulation jacket prevents condensation on the surface of pipes and increases storage space by eliminating dripping in the area below the pipes.

Circle No. 33 on Postcard

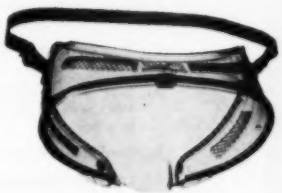
New Plastic Marking Tape

Labelon Tape Company, Inc., has developed a plastic marking tape on which all necessary data can be written and the tape applied directly to panels, circuit breakers, switches, fuses, wall outlets and as "flags" to wires and drop cords. The new tape is pressure sensitive, sticking without moistening to any dry and comparatively smooth surface.

It may be written on with a pencil or any pointed instrument, but the writing is not on the surface of the tape. It appears beneath a transparent plastic outer layer which protects it against smudging dust, dirt, oil, water and chemicals. Temperatures between —40°F. and 160°F. do not affect the tape. It is fadeless and provides a permanent label that can be stripped off one surface and re-applied to another.

Circle No. 34 on Postcard

All-Plastic Safety Goggle



An improved, all-plastic safety goggle is being offered by Willson Products, Inc. Outstanding feature of the new goggle is a flexible, fully transparent frame of molded Vinylite. Although the new frame conforms to all facial contours, a newly designed lens retaining feature adds sufficient rigidity to the frame so that there is no sacrifice of protective efficiency. The lens is of .060-inch acetate, and is separately replaceable. The goggle weighs just over an ounce and fits over all types of prescription gasses. It is known as the Wilson #91 MonoGoggle.

Circle No. 35 on Postcard

New Cation Exchange Resin

Having high regeneration efficiency and low leakage characteristics, new, medium capacity cation exchange resin, Amberlite IR-112, has been developed by Rohn & Haas Company. The resin is said to have all the desirable physical and chemical properties of the polystyrene nuclear sulfonic acid class of exchangers. It is resistant to oxidizing and reducing media, as well as to solvents. It is stable up to 250° F. and over the entire pH range. At the low regeneration levels customary in water conditioning, it exhibits exchange capacities virtually equivalent to older, sulfonic acid type exchangers.

Circle No. 36 on Postcard

Open Channel Flow Meters

The Bristol Company has revealed its new line of Series 500 Open Channel Flow Meters for measuring, recording and controlling the flow of water, sewage, industrial plant effluent, irrigation water, and other liquids. The flow is determined by measuring the head of liquid flowing through a flume or over a weir in the flow channel. This measurement of head is interpreted by means of a cam, cut to the equation of the weir or flume, into terms of flow, which is then recorded on a uniform chart and integrated if desired. Two general types are offered. In the mechanical type, the cam mechanically moves the pen arm across the chart. The electric type employs the Bristol timed-impulse type of remote recording. A descriptive bulletin is available upon request.

Circle No. 37 on Postcard

Versatile Fog Spray Nozzle

A versatile fog spray nozzle with a handy three-foot applicator, positive shut-off, and garden hose connection has recently been developed by Bete Fog Nozzle, Inc., and is known as the HX5 nozzle. It is suited for a variety of industrial uses where a portable nozzle with controlled spray pattern and volume is required. The HX5 operates at ordinary 30 to 100 psi pressures. Atomizing elements are a series of interchangeable fan spray discs machined from stainless steel. Discs are available for fan angles from 10 to 90 degrees with a 1/10 to 8 gpm flow.

Circle No. 38 on Postcard

Hot Water Treating Specialty

A new hot water treating specialty, an easily installed fitting for removing air at the boiler, has been introduced by The Trane Company. Design of the Trane Air-Reducer eliminates two adapter connections, thus enabling easier, and more economical boiler installation according to the manufacturer. The Air-Reducer is, in effect, a pipe within a pipe. The brass inner tube extends the hot water system's supply main below the surface of the water in the boiler, preventing air from entering piping and heating units. Air collecting at the top of the boiler is bled off to the compression tank through the outer casting. Additional information describing the Air-Reducer and the other Trane Hot Water Heating Specialties is contained in a new edition of Trane Bulletin J-355.

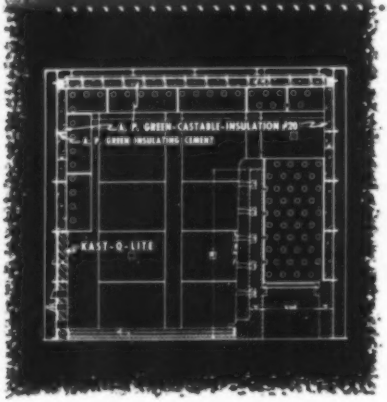
Circle No. 39 on Postcard

6 REASONS WHY

A. P. Green REFRACTORY PRODUCTS

A. P. GREEN

LIGHTWEIGHT CASTABLE REFRACTORIES REDUCE COSTS AND INCREASE EFFICIENCY IN OIL HEATERS AND OIL STILLS



Cross section drawing of an oil heater in Gary, Indiana. This heater is one example of the numerous uses for A. P. Green lightweight castable refractories in the petroleum industry.

For use in panel casing construction in new or old oil heaters and stills, A. P. Green castable refractories offer you these 6 advantages:

1. Lightweight insulating castables reduce heat loss . . . improve temperature control and heat distribution.
2. Securely anchored lining — gives long, trouble-free service.
3. Increases the performance and efficiency of the furnace. With fewer joints, air infiltration is reduced to a minimum.
4. Simplified construction — reduces erection time.
5. Lowers maintenance costs. Any tube section may be repaired by removing a series of the panels without disturbing the balance of the furnace arrangement.
6. Lower foundation costs due to the use of lightweight materials.

The A. P. Green Engineering Department will assist you with further information on the application of these materials to new units or the conversion of existing furnaces. Call your local A. P. Green distributor — he's listed in the yellow pages of your telephone directory — or write . . .

A. P. GREEN FIRE BRICK COMPANY
Mexico, Missouri, U. S. A.

In Canada
A. P. GREEN FIRE BRICK COMPANY, LTD. Toronto 15, Ontario
DISTRIBUTORS IN THE PRINCIPAL CITIES OF THE WORLD

The castable is poured and anchored to the steel panels on the job site. The simple formwork has been removed and the panels are awaiting erection.

Interior view of side wall showing panels being erected.

View of outside panel casing.

Protective Coatings Booklet

A general catalog covering the complete line of Prufcoat Protective Coatings has been released for general distribution by Prufcoat Laboratories, Inc. The catalog includes a list of chemical agents against which Prufcoat has been found effective, case history studies of five different types of applications in as many different industries, and a three point analysis of the advantages of maintenance painting. The back page of the catalog is devoted to a listing and brief description of the physical and protective qualities of all Prufcoat products.

Circle No. 40 on Postcard

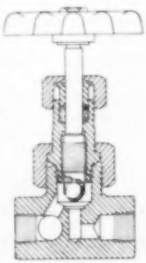
Revised Thermocouple Catalog

To present its complete line of standard thermocouple assemblies and parts, Leeds & Northup Company has published a newly-revised catalog, "Thermocouples—Assemblies, Parts and Accessories," which offers the latest information on available couples and couple assemblies for general applications, and includes an expanded section on special couples for plant and laboratory. The publication lists the accuracy limits of couples, the temperature and physical limitations of thermocouple materials for general applications. The expanded section on special couples includes those for such applications as open-hearth, glass feeder, pickling acid, steam plant, and blast furnace installations. Component parts of couple assemblies are fully described.

Circle No. 41 on Postcard

Tight Seating Ball Valve

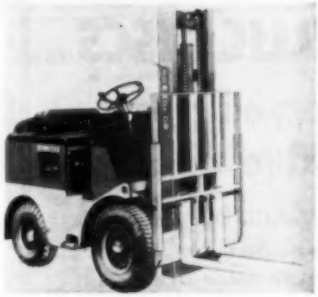
A new ¼-inch ball valve, recommended for working pressures up to 3000 psi, has been announced by The Foxboro Company.



Tight, positive shut-off is provided by a stainless steel ball which closes into a machined, conical seat. The ball, retained at the end of the stem, is free-rolling so that every closing brings a new surface into contact with the valve seat. Alignment of ball to seat is accurately piloted by a forged steel, union-type bonnet, fitting tightly to the body and assuring a correct valve closure. The long-stroke stem and the packing gland are made of stainless steel for durability and resistance to corrosion. The packing is a preformed, graphited asbestos with a plastic binder and can be replaced without shutting off the line pressure or interrupting the process. Straight-through and angle types are available with two and four connections.

Circle No. 42 on Postcard

Handling Multi-Unit Loads



Safe handling of unusually high multi-unit loads is the feature of the Towmotor Extension Backrest, a standard accessory engineered by Towmotor Corporation. Extending from the vertical carriage frame, the Towmotor Extension Backrest facilities handling stacks of case goods, bags, bales or other loads which normally extend above the top of the carriage. Designed for use with any Towmotor model, the Extension Backrest can be attached or removed in a few seconds. It is described in detail in a new Towmotor Data Sheet now available from the company.

Circle No. 43 on Postcard

Floor Resurfacing Material

A new floor resurfacing and patching material which provides an extra hard surface to facilitate hand trucking has been developed by The Monroe Company, Inc. Named Steelhard, the compound is made of extra tough resins and non-stone aggregates. According to the company, these form a hard, tough, resilient surface that permits the heaviest of loads to roll easily and smoothly. Developed for use over concrete indoors or out, Steelhard will withstand traffic four to six hours after application. It comes ready to use without mixing or thinning, and is easily applied over unroughened concrete by simply priming the old flooring surface, spreading Steelhard to a thick layer of approximately ¼-inch, and rolling to a smooth surface.

Circle No. 44 on Postcard

Additive for Lubricating Oil

The development of a new additive for lubricating oil which will permit efficient use of fuels with high sulfur content under "severest operating conditions" was announced recently by the Petroleum Chemical department of American Cyanamid Company. The new product, Aerolube 92, combines oil anti-oxidant and bearing corrosion inhibition properties with "highly effective alkaline detergency." It was designed specifically for use in Series 2 oils.

Circle No. 45 on Postcard

General Purpose Motors Data

Construction features, ratings and dimensions of Allis-Chalmers open drip-proof (Type AP) and splash-proof (Type APWW) squirrel-cage induction motors in ratings of one-half to 100 horse power are described in a new bulletin released by the company.

According to the bulletin, the motors are available with many special modifications such as totally-enclosed, vertical mounting, flange mounting and multiple speed construction.

Circle No. 46 on Postcard

Lithium Stearate Report

A technical service report describing the preparation and use of lithium stearate in the making of grease has been made available by Witco Chemical Company. It describes the more efficient method of preparing lithium greases and the components used in them. In addition to noting proper procedures for best results, tables and graphs are given which show the typical properties of lithium stearate and its performance in various base oils.

Circle No. 47 on Postcard

Commercial N-Propyl Acetate

The Chemical Division, Celanese Corporation of America has announced the commercial availability of N-Propyl Acetate. This material is available in tank car quantities and is a powerful active solvent used extensively in lacquer formulations. It is also available in tank wagon and drum lots. This product is the first in a series of esters to be manufactured by Celanese. The Technical Service department of Celanese can provide formulations with this product.

Circle No. 48 on Postcard

Automatic Liquid Level Gauge

A new automatic liquid level gauge for low pressure storage tanks has been developed by The Vapor Recovery Systems Company, incorporating a full-view, direct reading counter in the look box for quick, accurate reading of foot increments and a dial for reading inches and fractions of tank contents. The Neg'ator motor housed with the gauge head, maintains a pre-determined constant tape tension. Installation of the look box may be made at any desired height from the ground or on top of the tank. A patented gravity compensator is incorporated with an inch reading dial to permit adjustment in the look box to correct any error in reading due to gravity change of product.

Circle No. 49 on Postcard

THESE

3 NON-METALLIC DISCS

can save you hundreds of valve dollars

Lunkenheimer "N-M-D" (Non-Metallic-Disc) Valves save you maintenance time and replacement money. Each disc is compounded for a special service — and all are easily interchanged or replaced. You're sure of the *right* valve for the job when you stock Lunkenheimer "N-M-D's."

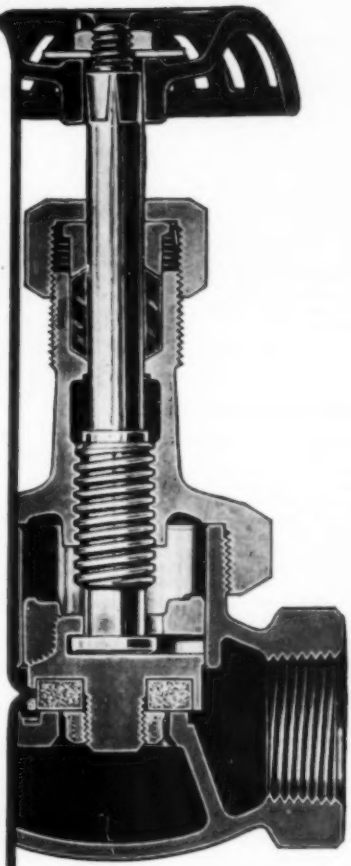
LUNKENHEIMER "N-M-D" Valves with No. 20 Discs handle 150 lb. saturated steam and hot water at pressures up to 300 lbs. and temperatures to 150°F. No. 20 Discs are designed for use on all Lunkenheimer "N-M-D" Globe, Angle, Check, and Quick Operating Valves where hot fluids are handled.

★

LUNKENHEIMER "N-M-D" Valves with No. 30 Discs are recommended especially for cold water, air, and gas service at pressures to 300 lbs. All Lunkenheimer "N-M-D" Valves can be converted from one service to another simply by exchanging the discs, which are identical in size and shape.

★

LUNKENHEIMER "N-M-D" Valves with No. 50 Discs are ideal for gasoline, oil, butane, and propane service. Disc-Holder for all "N-M-D" Valves is the slip-on type—four long guides prevent "cocking" and assure perfect disc seating. All three discs can be replaced or exchanged quickly.



WRITE FOR Circular 558, which includes complete details, dimensions, and service recommendations. It is available from your distributor or from The Lunkenheimer Co., Box 360G, Cincinnati 14, Ohio.

BRONZE • IRON • STEEL

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LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

Catalogs AND EQUIPMENT *Literature* OFFERED IN THIS ISSUE'S ADVERTISEMENTS

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WELDING AND CUTTING TORCHES—Catalog 2. Air Reduction Magnolia Co. See page 35.
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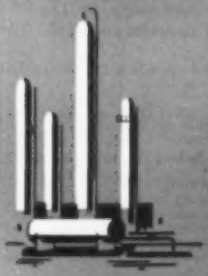


SERVICE

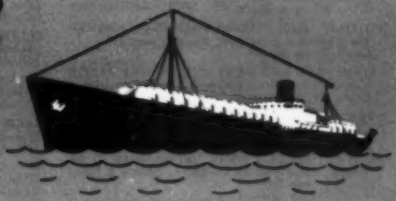
SERVICE SERVICE

SERVICE SERVICE

NATURAL GASOLINE
PROPANE
ISO-BUTANE
BUTANE
ISO-PENTANE

NORMAL PENTANE
HEXANE
HEPTANE
HEAVY NAPHTHA
STA-VOL-ENE

30 Service YEARS



WARREN

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Digest of Recent U. S. PATENTS Pertaining to PETROLEUM REFINING

Compiled by DR. HEINZ HEINEMANN

(From the Official Gazette, April 29, May 6, 13 and 20, 1952)

REFINING

U.S.P. 2,594,541-2. Process for Breaking Petroleum Emulsions. M. D. Groote and B. Keiser to Petrolite Corporation, Ltd.

In the breaking of petroleum emulsions a demulsifier is used which includes a cogeneric mixture of a homologous series of glycol ethers of oxy-alkylation-susceptible, fusible, soluble phenol-aldehyde resins or/of phenol-acetylene resins of certain well defined derivations.

U.S.P. 2,594,557. Purification of Aliphatic Hydrocarbons. A. E. Hirschler to Sun Oil Company.

A saturated mixture of two paraffin hydrocarbons of the same mol wt. is treated in liquid phase with a silica gel adsorbent, whereby one of the hydrocarbons is selectively adsorbed and separated from the other.

U.S.P. 2,594,880. Purification of Oils by Clay Contacting. H. R. Davis to The Lummus Company.

Clay fluidized with an inert gas is passed at a temperature below 212°F. into a chamber and oil to be purified is injected at a temperature of 300-650°F. into this chamber. The clay is wetted thoroughly with the oil and water is liberated therefrom. Inert gas and steam are withdrawn, while the remaining mixtare of clay and oil is further treated to remove light gases from the oil.

U.S.P. 2,595,170. Stabilized Mineral Oil. H. W. Rudel and A. D. Kirshenbaum to Standard Oil Development Company.

A mineral oil contains a minor amount of a product obtained by reacting a double-bonded non-aromatic, non-acetylenic hydrocarbon having at least three C atoms with a sulfur chloride or sulfur bromide and heating the resulting intermediate product with a dithiophosphate of the formula

$$RO \diagdown \overset{S}{\overset{\|}{P}} - SM \text{ where R is}$$
$$RO \diagup$$

a hydrocarbon radical with 2-30 C atoms and M is an alkali metal. The additive inhibits oxidation.

U.S.P. 2,595,284. Method and Apparatus for Treatment of Gaseous Hydrocarbon Mixtures. P. V. Mullins to the U. S. Secretary of the Interior.

In the treatment of gaseous hydrocarbon mixtures containing a substantial proportion of nitrogen as a diluent, the gas stream is refrigerated under increased pressure with effluent methane. The nitrogen and methane of the gas are liquefied by adiabatic expansion followed by heat exchange with colder nitrogen vapors. The resulting vapor and liquid fractions are refluxed with liquid nitrogen and further treated to remove and recover diluent nitrogen from the hydrocarbon gas mixture.

U.S.P. 2,595,338. Distillation of Carbonaceous Solids. G. D. Creelman to Pittsburgh Consolidation Coal Company.

Details are claimed of a process for the distillation of the oily components of solid carbonaceous material, such as oil shale, lignite and the like, which employs the hot distillation residue from a previous distillation for heating the material to be distilled.

U.S.P. 2,595,516. Process for Recovery of Tar Acids and Bases from Hydrocarbon Oils. E. W. Doughty, J. V. Murray, Jr., and J. D. Fales to Union Carbide and Carbon Corporation.

Hydrocarbons containing phenols are extracted with an aqueous solution of alkali-metal phenolates containing at least 20 percent by weight of the phenolates to form a solution of free phenols in this solution. The solution is then extracted with a neutral, normally liquid organic solvent immiscible with 40 percent aqueous sodium phenolate solution and boiling below 180°C, such as a dialkyl ether, to separate the free phenols from the aqueous phenolate solution.

U.S.P. 2,595,789. Diesel Fuel. J. B. Hinkamp and R. Sugimoto to Ethyl Corporation.

A diesel fuel contains a minor amount of a lower saturated aliphatic nitramine to decrease the ignition delay period of the fuel.

U.S.P. 2,596,175. Treating Hydrocarbons with Alkali Metal Hydroxides. L. Rosenstein to Texaco Development Corporation.

Hydrocarbons containing certain impurities are intimately contacted with a peptized colloidal system of alkali metal hydroxide and hydrocarbon in homogeneous colloidal dispersion with a hydrocarbon oil-soluble metallic salt of an organic acid as the peptizing agent.

U.S.P. 2,596,198. Motor Fuels. A. Bégue.

A motor fuel comprises gasoline, ethyl or methylalcohol, and .1-.5 cc of glycocholic or taurocholic acid or a soluble, alkaline salt of these acids per liter of motor-fuel.

U.S.P. 2,596,785. Method of Enriching Natural Gas. H. M. Nelly, Jr., and T. E. Sullivan to J. F. Pritchard & Company.

Natural gas is contacted with an absorbing liquid. The mixture is cooled. The residue gas is separated from the liquid and additionally cooled. It is then passed in counterflow with the liquid to effect further absorption of methane and heavier constituents from the residue gas. On fractionating the liquid thus obtained, a gas fraction of a relatively high btu content is formed.

U.S.P. 2,596,793. Process for the Extraction of Valuable Constituents from Unexposed Oil-Bearing Shales not Spent by Oxidation. E. J. Schabelitz.

Methylene chloride is forced at a temperature of 35-40.5°C. under a pressure of 100-1500 psi. for a period of one to five hours through unexposed oil-bearing shale not spent by oxidation. The constituents soluble in methlyene chloride are leached out and separated from the solvent. By fractional distillation of the product gasoline and light oil components were obtained.

U.S.P. 2,596,942. Filtration of Oils and Waxes with Bauxite. D. W. Robertson and C. W. Duchacek to Socony-Vacuum Oil Company, Inc.

The color of petroleum stocks such as oils and waxes is improved by filtration with bauxite in a state of hydration obtained by heating the bauxite to a temperature of 750°F. for two hours and then adding thereto at least two percent by weight of water.

U.S.P. 2,597,204. Process for Treating Petroleum Emulsions. R. W. Todd and F. E. Fuchs to Aquaness Corporation.

A water-in-oil petroleum emulsion is broken by a demulsifier consisting of the fatty acid esters of an oxyalkylated polyhydroxy compound obtained by a special process claimed.

U.S.P. 2,597,205. Stabilized Hydrocarbon Liquids. T. B. Tom to Standard Oil Company of Indiana.

A hydrocarbon distillate containing a sulfur compound corrosive to copper is incorporated with a small amount of the oil-soluble fraction of oilbanum to inhibit such corrosion.

U.S.P. 2,598,449. Purification of Naphthalene. R. Scott and E. H. Joscelyne to The Midland Tar Distillers Ltd., England.

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tinuously introduced into a flowing stream of precipitating liquid which is a solvent for the impurities, e.g. a stream of methyl alcohol, at a temperature of 20-40°C. Naphthalene crystals form immediately. The crystals are further treated to increase their size, subjected to a washing operation, and recovered.

CATALYST PREPARATION, ACTIVATION, AND REGENERATION

U.S.P. 2,594,554. Process for Concentrating Hydrogen Fluoride. O. M. Hanson and C. B. Linn to Universal Oil Products Company.

An aqueous solution of HF is contacted with another substantially anhydrous liquid hydrogen halide in sufficient amount to form a more concentrated HF layer and an aqueous hydrogen halide layer which are separated from another.

U.S.P. 2,595,056. Preparation of a Silica-Metal Oxide Gel Catalyst. G. C. Conolly to Standard Oil Development Company.

A pure silica hydrogel is soaked in a metallic salt solution to thoroughly impregnate the hydrogel therewith. Excess solution is drained off, and the hydrogel is then treated with a volatile base in an amount insufficient for complete reaction with the salt present, so that the gel formed remains acid. The product is washed and dried.

U.S.P. 2,595,339. Cogelation of Silica and Alumina Sols at pH 3.5-6.5. M. D. Herder and L. Heard to Standard Oil Company of Indiana.

Improved silica-alumina catalyst is prepared by mixing an alumina hydrosol having a pH of 3.5-6.5 into a silica hydrosol having the same pH limits. The mixture is allowed to set to a transparent, vibrant ultra gel which is washed, dried and calcined.

U.S.P. 2,595,415. Production of an Activated Form of Alumina. L. Schmerling to Universal Oil Products Company.

Alumina containing gamma-aluminum oxide is mixed with a carboxylic acid, such as acetic acid, of at least 60 percent concentration and in a proportion of at least four mols of acid to alumina. The mixture is heated to 150-300°C. under sufficient pressure to maintain a substantial portion of the acid in liquid phase for a time to convert the gamma-aluminum oxide to a basic Al-salt of the acid. Thereafter, this salt is heated at 250-800°C. to remove the organic acid radical and to form porous alumina useful as a catalyst.

U.S.P. 2,595,416. Production of Modified Forms of Alumina. L. Schmerling to Universal Oil Products Company.

The process according to this patent is very closely related to that of **U.S.P. 2,595,415.** It differs from the latter substantially only in that the conversion of the basic Al-salt to alumina can be effected by any suitable method.

U.S.P. 2,595,772. Method Of Preparing Catalysts. R. L. Daussat and C. T.

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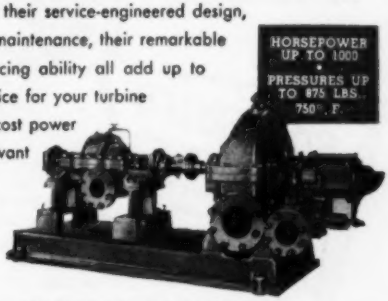

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Steele to Standard Oil Development Company.

A catalyst of mixed sulfides of an element of the left sub-group of group VI of the periodic system and of a metal of the iron group is prepared by treating an aqueous solution of a thioacid of said element with a salt of said metal to precipitate the sulfides of said element and of said metal. The metal salt employed shall be one, the anion of which forms with the cation of the thioacid salt, a compound which decomposes into volatile constituents upon heating the aqueous solution above 100°C., so that upon such heating all constituents except the precipitate are evaporated.

U.S.P. 2,595,943. Method of Hardening Bauxite with Calcium Sulfate. H. Heinemann to Porocel Corporation.

Thermally activated bauxite granules are mixed with a solution of a soluble calcium salt in an amount sufficient to give 2-10 percent $CaSO_4$ in the granules. The mixture is treated with dilute H_2SO_4, washed and heated to a temperature not exceeding 1200°F. A hardened catalyst useful in the treatment of petroleum is obtained.

U.S.P. 2,596,497. Process of Strengthening a Calcined Supported Phosphoric Acid Catalyst. J. M. Mavity to Universal Oil Products Company.

A calcined composite of a phosphoric acid and a solid supporting material is treated with an Al- on B-compound reactable with free phosphoric acid in the composite and being in sufficient amount to add 1-10 percent by weight of the phosphate reaction product to the composite. The composite is then recalcined and shows increased structural strength.

U.S.P. 2,596,498. Supported Phosphoric Acid Catalyst and Process of Manufacture. J. M. Mavity to Universal Oil Products Company.

The process of this patent is closely related to that of **U.S.P. 2,596,497.** An organo compound of Mg or Zn is here employed as the treating agent. The thermal stability of the composite is improved by the treatment.

U.S.P. 2,596,748. Catalyst Regeneration System. K. M. Watson and R. L. Smith to Sinclair Refining Company.

In a catalytic petroleum conversion process with regeneration of spent catalyst, uniform activity of the catalyst is maintained by constantly adding small amounts of fresh catalyst. The catalyst fines are carried overhead from the regeneration zone to the system. Further details are claimed.

U.S.P. 2,597,889. Drying a Silica-Zirconia Hydrogel Containing an Alkali Salt. T. H. Milliken, Jr., and I. H. Welinsky to Houdry Process Corporation.

A hydrogel containing silica and zirconia, having a pH less than seven and containing alkali salt in excess of that produced by the reaction forming the hydrogel, is dried. The dried gel is freed of alkali metal cations. A paste is prepared of the dried gel and formed into agglomerated pieces which are dried and calcined. An agglomerate-type catalyst is obtained.

CRACKING AND REFORMING

U.S.P. 2,595,909. Method and Apparatus for Treating Hydrocarbon Oils. R. P. Trainer and L. E. Border to Shell Development Company.

Details are claimed of a method and an apparatus for treating, and particularly for cracking, hydrocarbon oil with powdered catalyst.

U.S.P. 2,596,145. Method of Catalytically Reforming Hydrocarbons. H. W. Grote to Universal Oil Products Company.

An olefin-free straight-run gasoline fraction containing naphthenes and paraffins is subjected to catalytic dehydrogenation, for example in the presence of a platinum-alumina catalyst, to convert naphthenes to aromatics and to form hydrogen. The resultant hydrogen-containing product is mixed with an olefin-free, predominantly paraffinic, naphthene-lean gasoline fraction in an amount sufficient to lower the aromatic content of the mixture to below 25 percent. The mixture is then subjected to the action of a hydrocracking catalyst comprising Pt, Al and halogen under conditions to convert higher boiling into lower boiling paraffins.

U.S.P. 2,598,309. Catalytic Cracking of Hydrocarbon Oil. T. Say and J. F. McKinney, Jr. to Sun Oil Company.

In the catalytic cracking of hydrocarbon material in the presence of a stationary bed of silica-alumina catalyst which is periodically regenerated in situ and reused until the catalyst particles have undergone. partial permanent deactivation to a reduced activity level by a deposit of iron oxide poison, the de-

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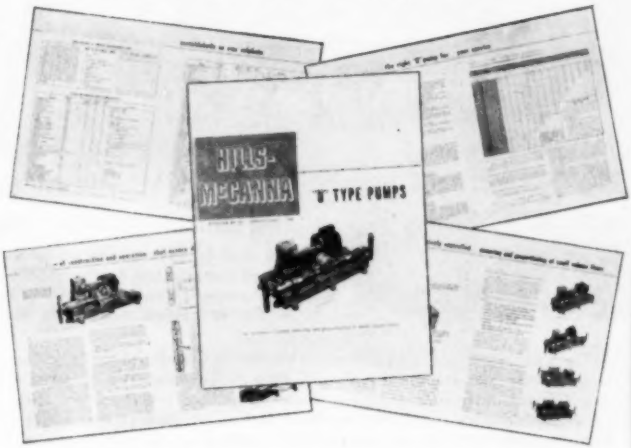

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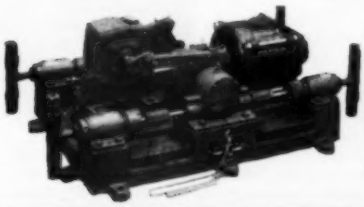
If your operations involve the metering or proportioning of small volume flows, you will find this catalog a useful addition to your files. We will be pleased to send you a copy on request. HILLS-McCANNA COMPANY, 2441 W. Nelson St., Chicago 18, Illinois.



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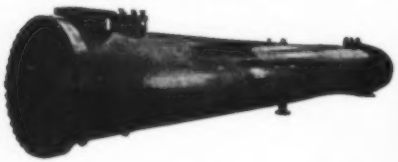

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Patents

activated particles are withdrawn from use in the stationary bed and transferred to a cracking system wherein the silica-alumina catalyst moves continuously as a compact bed through zones of reaction and regeneration. This process is continued until the deactivated particles have undergone additional permanent deactivation.

ISOMERIZATION

U.S.P. 2,594,706. Isomerization of Unsaturated Hydrocarbons. M. L. Allan to Imperial Chemical Industries, Ltd.

Allene is isomerized to methyl-acetylene by contacting the allene in the vapor phase at a temperature of 240-300°C. with a catalyst comprising alumina treated prior to use with silicon tetrafluoride or fluorine.

ALKYLATION

U.S.P. 2,594,343. Alkylation of Isoparaffins. H. Pines to Universal Oil Products Company.

An olefinic fraction containing an olefin having a terminal double bond, e.g. butene-1, is catalytically treated at isomerizing conditions to convert at least a portion of this olefin into one having a more central double bond. The treated fraction is mixed with an isoparaffin and a HF catalyst and alkylated at a temperature of 0-100°C.

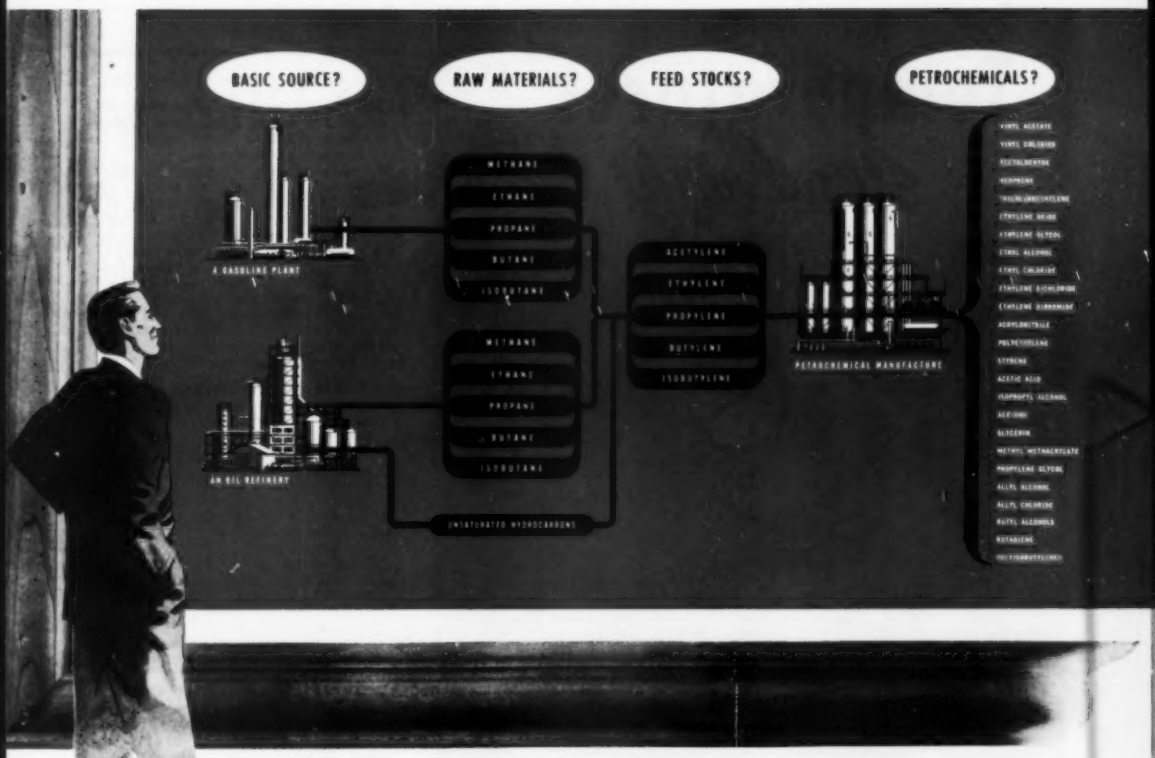
POLYMERIZATION AND CONVERSION

U.S.P. 2,594,289. Method and Apparatus for Processes Employing Fluent Solids. C. L. Caldwell to Houdry Process Corporation.

In an endothermic hydrocarbon catalytic conversion process with regeneration of spent catalyst, fluent solid conversion catalyst is passed through a confined zone of everywhere equal horizontal cross-section as a continuous downwardly moving nonturbulent bed. The lower part of this bed is divided into a plurality of non-communicating vertical sections. Hydrocarbons are passed through the upper part of this bed throughout its complete horizontal cross-section. An inert is introduced to the bottom of at least one of the vertical sections at a pressure greater than that at the top of this section to prevent entrance of hydrocarbon vapors to this section. Hydrocarbons are passed through at least one of the vertical sections, so that the rate of catalyst circulation through the upper part of the zone above said sections is greater than that through the vertical sections employed for contacting hydrocarbons.

U.S.P. 2,594,560. Low-Temperature Polymerization of Ethylenic Compounds Using an Initiators Compositions Comprising Sodium Azide and an Oxidant. E. G. Howard, Jr., to E. I. duPont de Nemours & Company.

Ethylenically unsaturated monomers, such as ethylene, propylene, butadiene, etc., are polymerized in aqueous dispersion by contact with an initiator system comprising azide ion and an oxidant thereof, viz. a periodate, hypochlorite,



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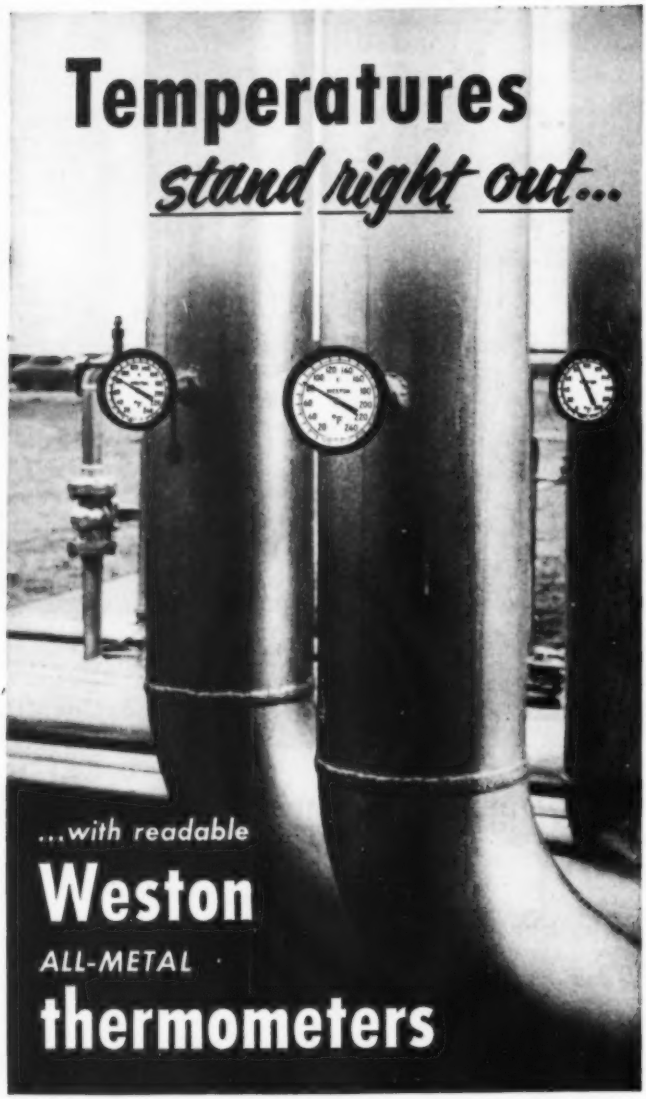

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Patents

permanganate, bromate, and ceric ion.

U.S.P. 2,594,913. Suspension Polymerization Employing Phosphates of Submicronic Particle Size. J. M. Grim to Koppers Company, Inc.

A polymerizable ethylenic monomer, e.g. styrene, is added to water. The suspension is stabilized by means of a phosphate difficultly soluble in water and containing for each phosphate group at least three equivalents of a metal the carbonate of which is at most only slightly soluble in water, such as Ca or Mg. The phosphate is comprised of particles predominantly of a size in the range of 0.2-0.005 micron. The thus dispersed ethylenic monomer is polymerized. Polymer beads are formed.

U.S.P. 2,595,224. Method and Apparatus for Processes Employing Fluent Solids. C. L. Caldwell to Houdry Process Corporation.

In the conversion of hydrocarbons in the presence of circulating fluid catalysts which are regenerated during the circulation, the catalyst is continuously moving downward through the reaction zone as a non-turbulent bed of equal horizontal cross-section throughout its vertical extension. A portion of the catalyst is withdrawn as at least one column at a point intermediate the vertical extent of the bed. Hydrocarbon vapors are disengaged from this portion at the point of its withdrawal. An unreactive gas is introduced to the compact column of catayst at a point beyond the conversion zone at a pressure greater than that in the conversion zone at the point of catalyst withdrawal to prevent the escape of hydrocarbon vapors from the conversion zone.

U.S.P. 2,595,234. Process for the Production of Fuel Gas from Carbonaceous Solid Fuels. D. B. Eastman to The Texas Company.

Fuel gas is generated from a solid carbonaceous fuel containing volatilizable constituents, such as oil shale, bituminous coals, and the like, by a process claimed in detail, wherein with the distillation of said constituents methanization of CO and H_2 is simultaneously effected.

U.S.P. 2,595,581. Thermal Polymerization of Alpha Methyl Styrenes. H. C. Highet, F. E. Salt, and H. M. Stanley to The Distillers Company, Ltd.

Alpha-methyl styrene or its lower nuclear homologues are heated, dissolved in an inert solvent in the absence of a catalyst and in liquid phase at a temperature of 290-350°C. to effect polymerization.

U.S.P. 2,595,892. Alkali Metal Alkyltoluene Sulfonates as Emulsifying Agents in Low Temperature Emulsion Polymerization Processes. W. A. Schulze and W. W. Crouch to Phillips Petroleum Company.

In the emulsion polymerization of conjugated diolefins the polymerization is the presence of an alkali-metal salt on a monoalkyl toluene sulfuric acid, the monoalkyl group of which contains 9-23 C atoms, as a emulsifier.

U.S.P. 2,596,610. Apparatus for Contacting Solid Materials with Fluids. H. A. Shabaker to Houdry Process Corporation.

The construction is claimed of an ap-

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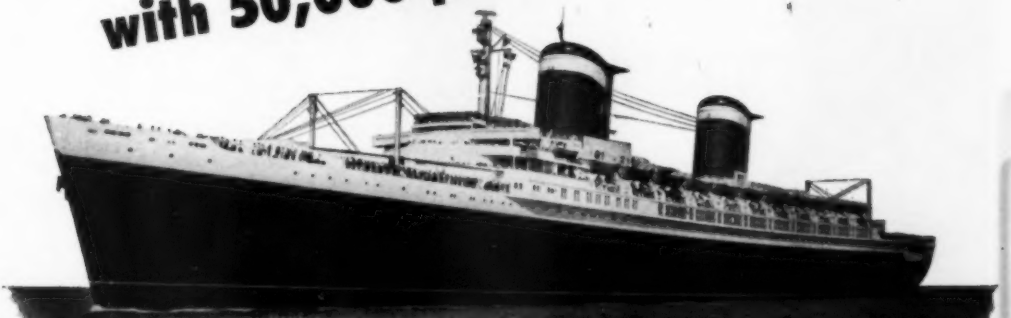

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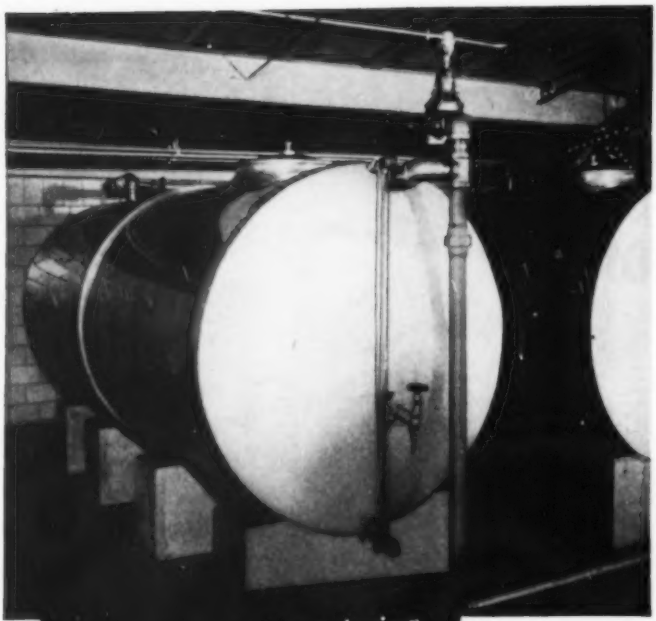

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Patents

paratus for contacting freely flowable solid materials with gaseous fluids. It is especially concerned with carrying out chemical reactions at elevated temperature with heat exchange between the solid materials and the gaseous fluids.

U.S.P. 2,596,975. Slurry Polymerization Process. J. H. Bannon to Standard Oil Development Company.

A mixture of a major proportion of isobutylene and a minor proportion of a multi unsaturated hydrocarbon having 4-14 C atoms and at least two aliphatic unsaturated linkages is polymerized in the cold in the presence of a liquid catalyst, such as a solution of $AlCl_3$ in CH_3Cl under special conditions to obtain a fine-grained slurry of solid polymer.

U.S.P. 2,597,346. Method for Effecting the Conversion of Organic Reactant Streams. F. W. Leffler to Universal Oil Products Company.

Details are claimed of a continuous method for pyrolytically converting a hydrocarbon stream, particularly for endothermic conversions, such as the reforming of low grade naphtha or gasoline to improve its octane number, by means of a moving bed of heated solid particles.

U.S.P. 2,597,951. Emulsion Polymerization Process. H. Romeyn, Jr., and C. D. McCleary to U. S. Rubber Company.

Details are claimed for producing a certain type of rubbery copolymers by emulsion polymerization of a mixture of butadiene and acrylonitrile.

U.S.P. 2,598,058. Continuous Conversion and Coking of Heavy Liquid Hydrocarbons. W. K. Hunter to Universal Oil Products Company.

A heavy hydrocarbon oil is reduced to coke by contact with inert solid heat-carrying particles, on which the coke is deposited. The resultant vapors are fractionated to separate therefrom low boiling products and a heavier liquid bottoms fraction. A portion of the resulting solid particle stream is treated in a combustion zone to burn coke deposit therefrom and is then returned in heated condition to the coking zone. Another portion of the solid particle stream is introduced with the liquid bottoms fraction to a flash zone wherein this fraction is partially vaporized by contact with said particles. A slurry of coked particles and the unvaporized liquid portion of the bottoms fraction is removed from the lower portion of the flash zone.

HYDROGENATION, DEHYDROGENATION, AROMATIZATION

U.S.P. 2,594,301. Catalytic Reduction of Carbon Monoxide with Hydrogen. D. B. Eastman and L. P. Gaucher to The Texas Company.

In a Fischer-Tropsch synthesis in the presence of a fluidized iron catalyst at a temperature of 500-700° F., the formation of gaseous hydrocarbons and CO_2 is restricted by withdrawing the entire reaction effluent from the catalyst, separating the normally liquid products therefrom, recycling the residual mix-

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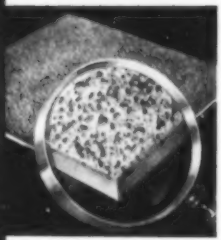

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ture of normally gaseous products to the inlet of the reaction zone at a predetermined well defined rate. Water vapor in a molar amount approximating the atomic quantity of carbon present as gaseous paraffins in the recycle stream in the absence of such water is continuously included in the feed to the reaction zone.

U.S.P. 2,594,341. Utilization of Oxo Bottoms. J. J. Owen and E. V. Fasce to Standard Oil Development Company.

Oxygenated organic compounds produced as still bottoms in a two-stage Oxo process are subjected to a selective oxidation process by means of an oxygen-containing gas in the presence of a metallic soap oxidation catalyst, whereby a mixture of fatty acids and alcohols is obtained.

U.S.P. 2,594,889. Synthesis of Cyclooctadiene-1, 5. R. M. Elofson to General Aniline & Film Corporation.

Cyclooctatetraene is heated with an alkali metal in a low boiling aliphatic alcohol. Cyclooctadiene-1, 5 is produced.

U.S.P. 2,595,096. Synthesis of Alcohol from Olefins, Carbon Monoxide, and Hydrogen. P. T. Parker to Standard Oil Development Company.

In a carbonylation process for the production of organic carbonyl compounds from olefins, CO and H_2 in the presence of a cobalt catalyst at a pressure below 4500 psi and wherein the resulting carbonyl compounds are reduced to alcohols which are subsequently distilled, the residue from this distillation is subjected to a hydrolysis in a neutral medium at temperatures above 300° F. At least a portion of the products thus obtained is hydrogenated. An increased over-all yield of alcohol is obtained.

U.S.P. 2,595,223. Separation of Organic Compounds. W. P. Burton and E. Solomon to the M. W. Kellogg Company.

The total reaction product obtained in the hydrogenation of carbon oxides is subjected in vapor state without prior condensation to scrubbing with an alkali at a temperature above the condensation point of normally liquid components contained therein. An extract comprising salts of fatty acids and a gas comprising the remainder of the reaction product are formed and separated.

U.S.P. 2,596,160. Separation of Organic Compounds. H. G. McGrath to The M. W. Kellogg Company.

In a Fischer-Tropsch synthesis for producing hydrocarbons and oxygenated organic compounds, the hydrocarbon-rich phase is extracted with a hydrocarbon-insoluble alcohol to obtain an extract containing a mixture of oxygenated compounds. The water-rich phase is separately extracted with a water-insoluble organic compound to obtain a corresponding extract. Both extracts are combined and hydrogenated under certain conditions to convert the oxygenated compounds to alcohols.

U.S.P. 2,596,434. Synthesis of Organic Compounds. R. Pyzel to The M. W. Kellogg Company.

In a Fischer-Tropsch synthesis wherein synthesis gas is passed upward through a mass of finely divided hydro-

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genation catalyst, a reaction effluent is cooled to form a liquid phase comprising relatively high-boiling and relatively low-boiling organic compounds. This liquid phase is stripped of the very low-boiling compounds. A small portion of the stripped liquid phase is fractionated to remove the highest boiling compounds and is then after further treatment injected into the mass of finely divided catalyst as a cooling medium.

U.S.P. 2,597,372. Production of Alkylcyclopentane Hydrocarbons and Benzenoid Hydrocarbons. H. Pines and V. N. Ipatieff to Universal Oil Products Company.

A cyclohexane hydrocarbon and a bicycloalkane hydrocarbon having a ring of 5 C atoms and another ring of 6 C atoms are reacted at a temperature of 200-450° C. in the presence of a dehydrogenation catalyst and at a pressure of 1-40 atm. Alkylcyclopentane hydrocarbons and benzenoid hydrocarbons are produced.

U.S.P. 2,598,186. Process for Use of Spent Fischer-Tropsch Catalyst for Manufacture of Carbon Monoxide-Hydrogen Synthesis Gas. B. J. Mayland to Phillips Petroleum Company.

A mixture of spent Fischer-Tropsch synthesis catalyst containing spent oxygen donor in the form of the catalyst metal oxide is contacted with steam and hydrogen. All of the carbon and waxes deposited on the catalyst are removed thereby, while the catalyst and oxygen donor are partially oxidized in the heat carried by the oxygen donor from the synthesis gas producing process. At least a portion of the resulting mixture is completely oxidized and preheated by contact with hot gases containing an excess of oxygen. This hot oxidized material is utilized as an oxygen donor and heat supplier in a Fischer-Tropsch synthesis gas producing step, while the remaining portion of the mixture is reduced and used as a catalyst in the Fischer-Tropsch hydrocarbon synthesis.

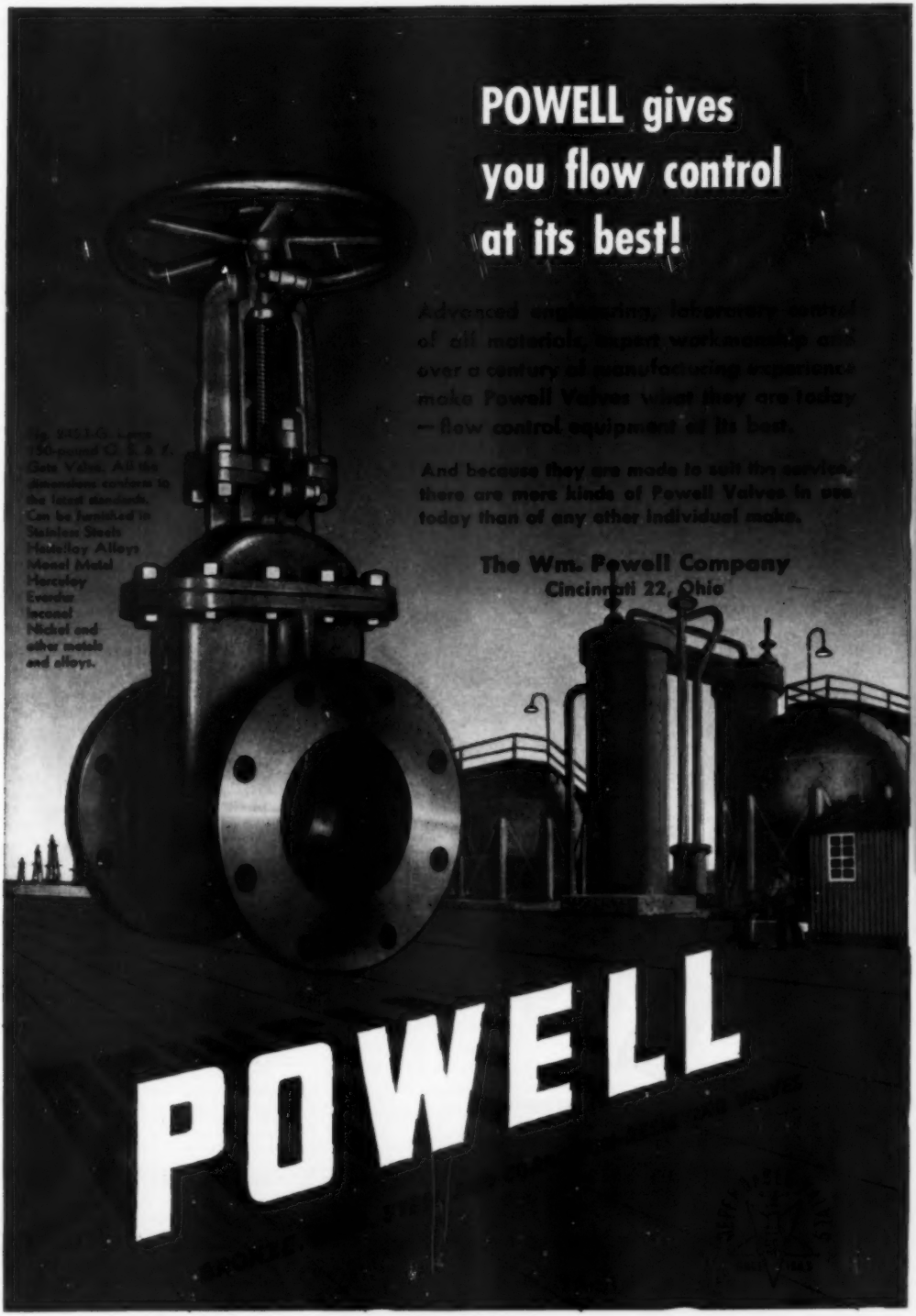
U.S.P. 2,598,503. Synthesis of Organic Compounds. W. P. Burtin to The M. W. Kellogg Company.

In a Fischer-Tropsch synthesis using a fluidized iron-containing catalyst containing a predetermined amount of 0.1-3 percent alkali or earth alkali compound promoter, the regenerated catlyst before being returned to the reaction zone is admixed with fresh promoter in an amount at least sufficient to partially compensate for the decrease of the catalyst in alkali content but insufficient to increase its alkali content over the initial amount.

U.S.P. 2,598,642. Process of Aromatizing Hydrocarbons with Metal Fluoride Catalyst in Presence of Oxygen and Hydrogen Fluoride. F. R. Hurley to Monsanto Chemical Company.

N-Heptane is contacted with a dehydrocyclization catalyst comprising the combination of manganese fluoride and iron fluoride in certain proportions, at a temperature of 450-600° C. in the presence of minor proportions of oxygen and HF. Cyclic hydrocarbons, such as toluene, are formed.

U.S.P. 2,598,647. Hydrogenation of Carbon Monoxide with Promoted Iron Catalyst. H. G. McGrath to The M.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Details are claimed of a process for hydrogenating CO with a fluidized iron catalyst containing an alkali metal oxide promoter. A relatively high yield of oxygenated organic compounds with more than 1 C atom is obtained.

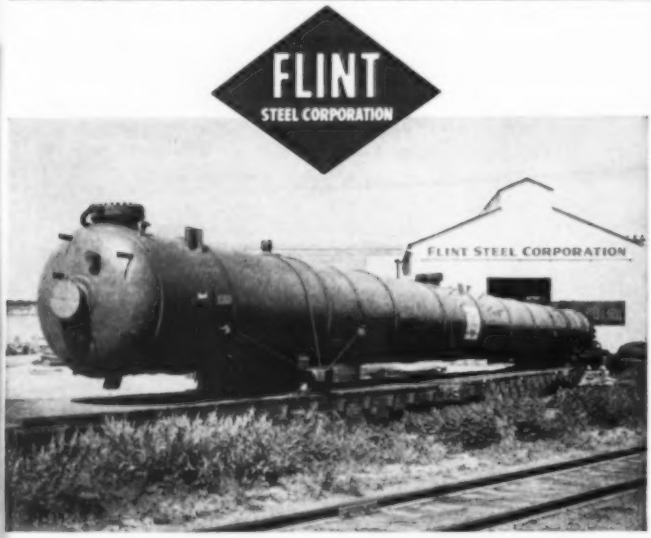
DESULFURIZATION

U.S.P. 2,594,311. Removal of Carbonyl Sulfide from Liquefied Petroleum Gas. A. B. Johnson and D. H. Condit to California Research Corporation.

Petroleum hydrocarbon gases containing COS but no other sulfur compounds are intimately dispersed in liquid phase in an aqueous solution of monoethanolamine and an alkali metal hydroxide present in the proportions of 3-6 mols thereof per mol of the amine. COS is removed by this treatment.

U.S.P. 2,596,692. Method of Absorbing Gases, Including Hydrogen Sulfide. J. T. Jordan to Shell Development Company.

A hydrocarbon gas containing impurities, particularly H_2S, is passed under pressure into contact with an absorption oil containing the impurities to absorb a fraction of the hydrocarbons. The fat absorption oil formed is separated from the unabsorbed gas. A small portion of the latter is passed under pressure into contact with a lean absorption oil. The thus purified unabsorbed gas is separated from the resulting solution of impurities in absorption oil, and the latter is utilized as the absorption oil in the first absorption step.



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U.S.P. 2,597,427. Preventing the Development of Sourness in Certain Petroleum Liquids During Distillation. G. W. Ayers, M. J. Geerts, and R. E. Chandler to The Pure Oil Company.

In order to prevent sourness in sweet products derived from petroleum hydrocarbons containing organic sulfur compounds during heating to temperatures at which such compounds are converted into sour-producing compounds, the heating is carried out in the presence of a small amount of glycerine.

U.S.P. 2,598,034. Desulfurization of Hydrocarbon Gases. K. M. Brown and C. G. Gerhold to Universal Oil Products Company.

A mercaptan containing hydrocarbon gas stream is contacted with a mercaptan solvent. The desulfurized gas stream is separated. The mercaptans in the enriched solvent are converted to disulfides. At least a portion of the solution containing the disulfides is supplied to the contacting step.

HEAVY OILS AND WAXES

U.S.P. 2,594,279. Mineral Oil Compositions. L. E. Beare to Sinclair Refining Company.

A mineral lubricating oil contains a minor amount of an oil-soluble stable chlorinated hydrocarbon with 35-75 percent chlorine and a composition prepared by the reaction of a bicyclic terpene, sulfur, and a phosphorus sulfide in certain proportions. The additives give extreme pressure properties to the oil.

U.S.P. 2,594,286. Grease and Grease Base. W. C. Bryant and H. Frost, Jr., to Swan-Finch Oil Corporation.

A grease comprises a petroleum lubricant and a gelatin agent of the formula

$$RNHC(CH_2)_x\text{-}\overset{O}{\overset{\|}{C}}NYR_1$$

in which R and R_1 are aliphatic hydrocarbon radicals, R having a C chain of C_8 to C_{18}, and R_1 having a C chain of C_2 to C_{18}, x equals 1-8, and Y is H or a second R_1 group.

U.S.P. 2,594,795. Lubricating Composition. L. L. Neff to Union Oil Company of California.

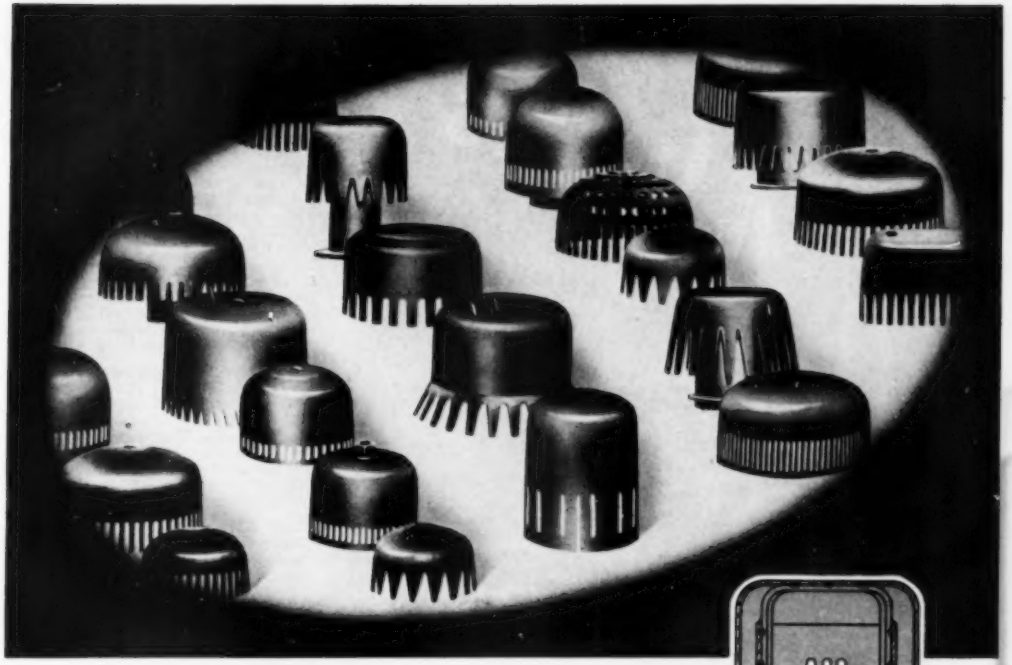
A mineral lubricating oil contains 0.2-15 percent by weight of an oil-soluble condensation product of a hydrocarbon substituted phenol with acetylene or of an oil-soluble metal salt thereof, obtained in a manner claimed in detail. The additive imparts to the oil characteristics adapting them for use in diesel engines, other internal combustion engines, and the like.

U.S.P. 2,594,822. Preparation of Greases. F. H. Stross and R. F. Moore to Shell Development Company.

An alcoholate of a polyvalent metal, such as Al or Ca, is dispersed in a lubricating oil and then hydrolyzed to form a metal hydroxide. Nonmetallic hydrolysis products are removed. A grease is formed.

U.S.P. 2,595,140. Oxidation Resistant Lubricating Oil Composition. R. L. Heinrich to Standard Oil Development Company.

An oxidation resistant lubricating oil comprises a polymer boiling in the lubricating oil range of an alpha-olefin with 5-10 C atoms, e. g. octene-1, and 0.1-2.5



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Patents

percent by weight of a carbazole.

U.S.P. 2,595,158. Rust Preventing Composition and Method of Preparing Same. C. F. McCue and W. E. J. Broom to Standard Oil Development Company.

A solution of a microcrystalline wax in a hydrocarbon solvent boiling between 40-150° C. is mixed in heated conditions with 0.5-3 percent of metal soap of C_{10}-C_{22} fatty acid and 0.5-3 percent of a rust inhibitor. The mixture is rapidly chilled with agitation to obtain a stable suspension of small wax particles in salt water. The product forms a hard rust preventing coating on metal surfaces.

U.S.P. 2,595,161. Lubricating Composition. A. J. Morway and D. W. Young to Standard Oil Development Company.

A lubricating oil is thickened to grease by a metal soap of a fatty acid combined with a minor amount of bis (5-methyl-2 hydroxy phenyl) sulfide to inhibit oxidation.

U.S.P. 2,595,169. Steam Turbine Lubricants. H. W. Rudel and J. I. Wasson to Standard Oil Development Company.

A mineral base lubricating oil contains 0.01-0.5 percent by weight of a thioether substituted tetrahydrophthalic or hexahydrophthalic acid, anhydride, or monoester thereof of special constitution. The additive inhibits corrosion.

U.S.P. 2,595,468. Solvent Separation of Wax from Hydrocarbon Mixtures. W. Kiersted, Jr., and H. H. Gross to Texaco Development Corporation.

Details are claimed of a process for the separation of solid wax from a hydrocarbon oil stock by a dewaxing solvent.

U.S.P. 2,595,819. Lubricating Oil Additives. W. H. Smyers and D. W. Young to Standard Oil Development Company.

A mineral lubricating oil contains an amount of 1-20 percent by weight of a P_2S_5 reaction product of a solution of styrene-isobutylene or polymer of certain proportions and properties in sperm oil.

U.S.P. 2,597,018. Lubricant. R. L. Merker and C. R. Singleterry.

A thickened lubricating composition comprises a lubricating oil and up to 45 percent by weight of a phthalocyanine dispersed therein in a proportion sufficient to cause gel formation in the oil.

U.S.P. 2,597,838. Lubricant Containing Selenium Compounds. W. Lowe, W. T. Stewart, and J. O. Clayton to California Research Corporation.

A selenium containing lubricating oil is compounded with a small amount of a 2-mercapto-thiazine of special constitution. The additive inhibits the corrosion of silver when this metal is in contact with the lubricant.

U.S.P. 2,597,908. Production of Lubricating Oil. H. R. Stewart and W. M. Thaw to California Research Corporation.

Petroleum wax is chlorinated to such an extent that the whole reaction product has a chlorine content in excess of 20 percent by weight. This product is catalytically dehydrochlorinated by con-

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Patents

tact with at least 5 percent of a silica-alumina catalyst at a temperature of 600-725° F. for a time sufficient to completely remove the chlorine and to produce a relatively saturated lubricating oil.

U.S.P. 2,597,910. Production of Lubricating Oil from Wax. W. M. Thaw and H. R. Stewart to California Research Corporation.

The process of this patent is closely related to that of **U.S.P. 2,597,908.** The chlorination of the petroleum wax is here effected at a temperature below 300° F. to an extent that the product has a chlorine content of less than 16 percent.

U.S.P. 2,598,154. Process for Making Grease. G. C. Bailey and W. B. Whitney to Phillips Petroleum Company.

A mixture of a hydrocarbon lubricating oil with a metallic soap is heated with agitation to disperse the soap in the oil. The dispersion is suddenly chilled to form a hard friable gel in some free oil. The gel is separated from a portion of this oil and is then worked together with the remaining free oil to a state of constant consistency of grease-like nature.

U.S.P. 2,598,257. Wax Product and Process for Preparing the Same. J. B. Hill and S. W. Ferris to Sun Oil Company.

A petroleum wax product suited to the lamination of paper products required to withstand high temperatures has an m. p. of at least 180° F. an A.S.T.M. penetration of at least 15 and other characteristics.

PETROCHEMICALS

U.S.P. 2,595,254. Apparatus and Process for Circulating Powdered Solid in Chemical Treatment. C. E. Hemminger to Standard Oil Development Company.

Details are claimed of a method and an apparatus for continuous chemical treatment of a gasiform material, e. g. the oxidation of naphthalene to phthalic anhydride, with a powdered solid material which may have catalytic properties. The process is particularly concerned with the temperature control in such processes.

U.S.P. 2,595,255. Production of Hydrocarbons from a Granular Solid Reactant. C. H. Holder to Standard Oil Development Company.

The patent relates to the production of hydrocarbons, e. g., benzene, from granulated calcium carbide and steam. Details are claimed.

U.S.P. 2,595,265. Process of Oxidation of Ethyl Naphthalene. R. Johnson to Koppers Company, Inc.

Ethyl naphthalene is treated with an oxygen-containing gas in the presence of cobalt stearate, cobalt naphthenate, cupric acetate, manganous acetate, carbonate or naphthenate, or chromic naphthenate at a reactive temperature below that at which dehydration of methyl naphthyl carbinol occurs. After removing insoluble materials and acidic by-products the remainder is subjected to distillation at reduced pressure to distill over methyl naphthyl carbinol formed. A fraction is recovered boiling

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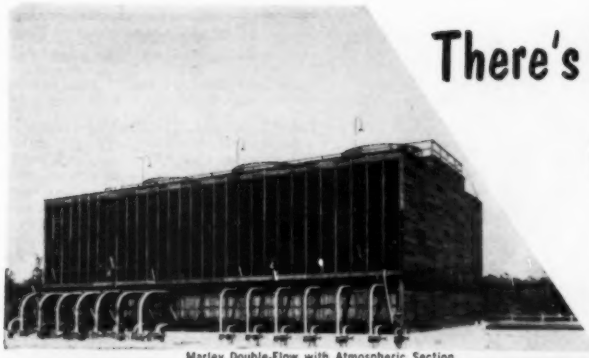

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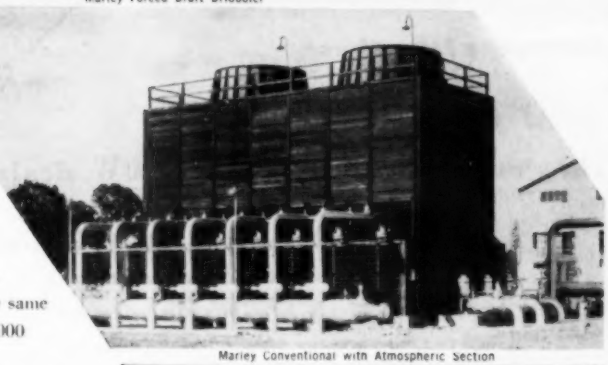
Marley Dri-Coolers are increasingly popular as more and more plants utilize air cooled heat exchange. The flexibility of header design and finned tube arrangement makes Dri-Coolers ideal for cooling of jacket water and lube oil and other high level cooling, either singly or both in the same unit. They now serve plants from 50 hp to 23,000 hp, in many countries and climates.

For water cooling, Marley has long set the standard. Marley patented Double-Flow, Conventional induced draft and atmospheric towers are all adaptable for indirect cooling through standard Marley atmospheric sections. Marley towers and sections are completely integrated units and the range of sizes fits every requirement of any size plant.



Marley Conventional with Atmospheric Section

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PRECOOLING AIR is another function of Marley cooling towers. In a single installation 40 Marley Aquatowers are in this type service.

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Patents

as an azeotrope of this carbinol and methyl naphthyl ketone, also formed.

U.S.P. 2,595,227. Electrical Oxidation of Aralkyl Hydrocarbon. W. J. Cotton.

A gaseous mixture of primarily toluene, oxygen and nitrogen is subjected at a temperature below its ignition temperature to the action of crossed electric discharges exhibiting a luminous field completely confined by gas. One of these discharges is an electromagnetic discharge of a frequency greater than that of the other by at least 0.065 megacycles per second expressed as sinusoidal-frequency equivalents. The nitrogen is thereby activated to an oxidation catalyst. Benzaldehyde and benzoic acid are formed.

U.S.P. 2,596,084. Fluorinated Compounds and Process of Producing the Same. P. E. Weimer to the U. S. Atomic Energy Commission.

A polyalkyl condensation product of a 2-4 C atom alkyl group with a dinuclear aromatic hydrocarbon, e. g. of ethylene with naphthalene, is reacted in vapor form with AgF_2 or CoF_3 at temperatures of 200-400° C. A perfluorinated oil is obtained which is useful as a lubricant.

U.S.P. 2,596,421. Flame Synthesis of Hydrogen Cyanide. A. C. McKinnis to Union Oil Company of California.

A reactant gas mixture containing certain proportions of ammonia, methane or natural gas, and oxygen is passed to a synthesis flame maintained by the combustion of the gas mixture. An auxiliary flame surrounding the synthesis flame is formed by a burning mixture of hydrogen and oxygen. The synthesis flame thereby takes the form of a thin flat disc of certain dimension in the direction of propagation, such that the time of passage of the reactant gas through this flame is less than 1×10^{-4} second. The product is immediately cooled below reaction temperature. Hydrogen cyanide is obtained.

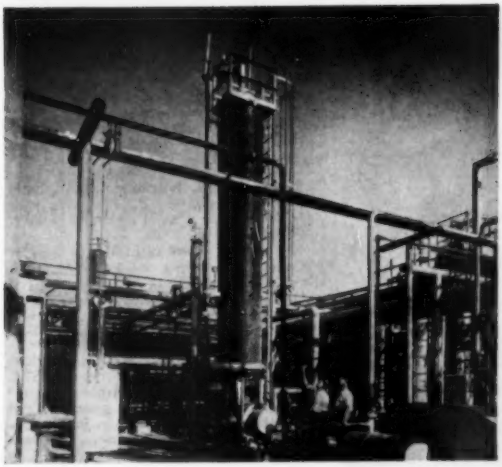
U.S.P. 2,596,507. Manufacture of HCN. C. W. Perry to Phillips Petroleum Company.

HCN is continuously manufactured from streams of NH_3 and CO or low mol wt. hydrocarbons by means of non-catalytic heated pebbles. Details of the process are claimed.

U.S.P. 2,597,027. Production of Nitroparaffins. H. J. Passino and L. C. Rubin to The M. W. Kellogg Company.

Ammonia and an oxidizing gas are passed through a heating zone at a temperature of 800-1000° C. and a pressure of 1015 atm. in the presence of a catalytic material to convert a substantial proportion of the ammonia to nitric acid in the vapor state. The resulting vapors are contacted immediately upon formation with gaseous paraffin hydrocarbons at a temperature slightly below the cracking temperature of the hydrocarbons to form the corresponding nitroso-paraffins. The nitroso-paraffin is further oxidized at a reduced temperature with additional oxidizing gas to form the nitro-paraffins.

U.S.P. 2,597,159. Condensation of Aromatic Hydrocarbons with Formaldehyde Catalyzed by Formic Acid. P. D. May and R. J. Lee to Pan American



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Patents

Refining Corporation.

An aromatic hydrocarbon having at least one unsubstituted nuclear C atom and formaldehyde are contacted with a formic acid catalyst at a temperature of 10-130° C. An organic condensation product is formed.

U.S.P. 2,597,698. Nitration of Aliphatic Hydrocarbons. G. B. Bachman and J. V. Hewett to Purdue Research Foundation.

The vapor phase nitration of hydrocarbons with nitric acid or nitrogen dioxide is effected in the presence of catalytic proportions free chlorine, bromine, or iodine, or oxidizable compounds thereof.

U.S.P. 2,598,263. Esterified 4-Vinylcyclohexene. H. L. Johnson and F. J. Bondhus to Sun Oil Company.

4-Vinylcyclohexene is reacted with a C_2-C_8 aliphatic acid, an alpha-halo or alpha-hydroxy substituent thereof, or benzoic or toluic acid in the presence of an acid-type catalyst at a temperature of 75-130° C. The corresponding monoester of 4-vinylcyclohexene is obtained having the ester group attached to the 1-position of the cyclohexene ring.

U.S.P. 2,598,424. Production of Cyclopentadiene-Tall Oil Compositions. C. F. Peters to Velsicol Corporation.

Cyclopentadiene is reacted with tall oil at a temperature of 400-650°F. The new composition obtained is useful as a surface coating material valuable particularly in the paint and varnish field.

U.S.P. 2,598,425. Production of Cyclopentadiene Resinous Material Reaction Products. C. F. Peters to Velsicol Corporation.

This patent is closely related to **U.S.P. 2,598,424.** Rosin, abietic acid, polymerized rosin, or a rosin ester is here reacted with cyclopentadiene under corresponding conditions.

Chemicals Wanted

The National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, has received urgent requests for the chemicals listed below. If anyone has one or more, even if only one gram quantities, please inform the Registry.

1,9-Benzanthrone
1,12-Benzperylene
4,4'-Dialdehydodiphenyl
N,N-Diallylaniline
Retene
sym.-Diisopropyl hydrazine
Mellitic acid
Methanesulfonic acid
Sodium dithioformate
Aluminum triethyl
5,9,10-Trimethylbenzanthracene
1,12-dodecanedioic acid
n-Tridecylamine
4-(2-ethylhexyl) phenol
1,2-Di-(alpha naphthyl) ethylene
5-Methyloxine
5-Aminooxine
Dimethyl selenide
Dimethylcyclopropane

BOOKS of Current Interest

Properties of Metals

Mechanical Properties of Metals at Low Temperatures, National Bureau of Standards, Government Printing Office, $1.50.

Many mechanical devices and equipment operate at low temperatures; and the consequent embrittlement of materials, accompanied by brittle failures, is of concern to designers, manufacturers and users. The subject continues to increase in importance with the steady growth of the refrigeration industry and the expanding demand for the liquefaction, transportation and storage of many gases.

This volume presents results of studies conducted both in industry and in government to further knowledge of the behavior of metals at low temperatures, which is important to an understanding of their fundamental rheological properties. The papers were intially presented at the Symposium on the Influence of Low Temperatures on the Mechanical Properties of Metals held at the National Bureau of Standards in 1951.

Papers included in the volume cover recent European work in the field; manufacture of steels, development and application of chromium-copper-nickel steel, and application of metals in aircraft for low-temperature service; tensile properties of copper, nickel, and some copper-nickel alloys, properties of austenitic stainless steels, and mechanical properties of high-purity iron-carbon alloys at low temperatures; dimensional effects in fracture; and brittle fractures in ship plates.

Gas Law Deviations

Measurement of Gas Law Deviations with Bean and Burnett Apparatus, O. T. Bloomer, Institute of Gas Technology Research Bulletin No. 13, Institute of Gas Technology, 17 West 34th Street, Chicago 16, Ill., $2.

The bulletin presents a comparative study of the Bean and Burnett apparatus as to accuracy and reproducibility in determination of deviations from the ideal gas law, and ease of operation in obtaining this data and in calculation of the results.

The bulletin describes in detail the operation and calibration of the equipment, giving sample data and calculation sheets for both, and certain precautions to be observed in charging the equipment. The volume thus not only presents a comprehensive, comparative study of the two apparatus, but serves also as an instruction manual and guide book for their use.

Waste Gases Disposal

Manual of Refinery Wastes, Volume II—Waste Gases and Particulate Matter, Technical Committee on the Development of the Technology of Waste Disposal, American Petroleum Institute, 50 W. 50th Street, New York 20, N. Y., $1.50.

This publication deals with the disposal of waste gases and airborne ma-

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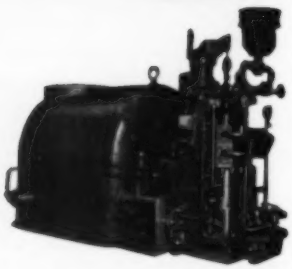

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Books

terials in petroleum refineries. It contains information which, if applied by refiners, will help to prevent the escape of noxious or offensive gases and other airborne wastes. The manual is a part of the petroleum industry's approach to the problem of waste disposal. For more than 20 years, the American Petroleum Institute has had a technical committee at work on the development of the technology of waste disposal. The results of the committee's work are published in a Manual of Refinery Wastes broken down into three volumes.

Methane-Nitrogen Mixtures

Physical-Chemical Properties of Methane-Nitrogen Mixtures, O. T. Bloomer and J. D. Parent, Institute of Gas Technology Research Bulletin No. 17, Institute of Gas Technology, 17 West 34th Street, Chicago 16, Ill., $3.50.

The rapid rate at which natural gas reserves are being dedicated to satisfy the ever-increasing demand forecasts the necessity for using supplies of increasingly higher nitrogen content. Proposals have been made to remove part or all of the nitrogen prior to transmission, as a means of lowering pumping costs by increasing the effective pipeline thermal carry capacity. Of added interest is the storage of natural gas as liquid, which requires the separation of nitrogen in the liquefaction process to increase the effective capacity of storage systems and to avoid fractionation and consequent change of composition and heating value upon gasification.

Reliable, adequate vapor-liquid phase data on the methane-nitrogen system, necessary for engineering design of nitrogen-removal equipment, is presented for the first time in this volume. The studies reported in it were initiated in 1947 under the Institute's basic research program, and since 1950 have been sponsored by the Technical and Research Committee, Natural Gas Association of the American Gas Association.

Dictionary Of Petroleum

Petroleum Dictionary And Products Manual, Petroleum Educational Institute, Dept. E, 9020 Melrose Avenue, Los Angeles 46, Calif., $8.

This book may prove of value especially to buyers, sellers, consumers and salesmen of petroleum products who do not possess a technical background. Included are definitions of hundreds of lubricating and other oils, more than a score of different gasolines, information about the additives generally used in present day fuels and lubricants and definitions of greases, terms connected with the origin, history, drilling and production of crude oil and descriptions of diesel and spark engines. Much of the factual information about the use and application of petroleum products, secured by the Institute during 16 years research in connection with their home study courses in fuels and lubricants, is included. The book gives an understandable definition of the technical and semi-technical terms generally found in periodicals, books and other literature in connection with the application and use of petroleum products and much of the equipment utilizing these products and

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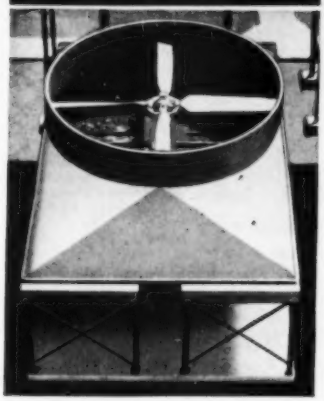

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Books

what these tests mean to sellers, buyers and users of petroleum products.

Carbureted Water Gas Oils

Selection of Oils For Carbureted Water Gas, E. S. Pettyjohn and H. R. Linden, Institute of Gas Technology Research Bulletin No. 9, Institute of Gas Technology, Technology Center, Chicago 16, Ill., $4.

This bulletin is a summary of the work done from November, 1947, through December, 1949, in a study of "The Enriching Value of Oils for Carburetion" for the Gas Production Research Committee of the American Gas Association. Presented are data on the relationships of the physical and chemical characteristics of petroleum fractions, and of the operating variables, with the enriching values and with the qualities and quantities of the gaseous and liquid products. Nomographs and equations included in the bulletin permit accurate calculations of these values for any oil, and indicate the operating variables most suitable for the selected oil and most favorable distribution between gaseous and liquid products.

Preventive Maintenance

Practical Preventive Maintenance for Gas and Diesel Engines. The Cooper-Bessemer Corporation, Mount Vernon, Ohio, $2 each.

A highly practical maintenance program to insure continuous and efficient operation of gas and diesel engines has been carefully developed by The Cooper-Bessemer Corporation. Field experiences show this program to be superior to conventional methods for maintaining such equipment.

Cooper-Bessemer's preventive maintenance program is detailed in its two newest manuals. One manual covers Gas-Diesel and Diesel engines; a second manual covers gas engines. In contrast to the usual periodic 8000-hour overall check or the progressive type maintenance schedule, Cooper-Bessemer's manuals show how to perform continuing checks on engines while in service to accurately forecast internal conditions of the engines and anticipate operational needs.

High-BTU Oil Gas Oils

Selection of Oils for High-BTU Oil Gas, H. R. Linden and E. S. Pettyjohn, Institute of Gas Technology Research Bulletin No. 12, Institute of Gas Technology, Technology Center, Chicago 16, Ill., $5.

This bulletin presents experimental data obtained in the thermal gasification of typical gas-making oils under conditions simulating present and anticipated high btu oil gas manufacturing practice, using a 2½-inch I.D., externally heated, laboratory cracking tube. The operating variables considered were the cracking temperature, the residence time at temperature, and the partical pressure of the oil gas leaving the cracking zone. The oils were characterized by their carbon-hydrogen weight ratios and their Conradson carbon residues.

Using experimental data, a method of evaluation and selection of oils for high-btu oil gas production was developed in terms of the net costs per therm of the true oil gases produced.

Nothing happens for weeks, months, even years at a time. So your Watchman gets lax. You get lax. Lulled by a false sense of security, you stretch your luck.

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About EQUIPMENT and SERVICE Suppliers

OPEN HOUSE—More than 850 employes, friends, customers, distributors and suppliers were guests of the Yarnall-Waring Company, Philadelphia, Pa., manufacturers of steam plant equipment, at a recent open house where the above photo was taken. Featured attraction of the event was a series of conducted tours through the expanded plant and new office buildings. Guests in groups of 15 were shown throughout. One of the high points of interest was Yarway's research department where 2500 psi boiler plant tests Yarway equipment. The Yarnall-Waring Company was founded in 1908 by Bernard G. Waring and D. Robert Yarnall, who continue to actively head-up the company.

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H. R. Fosnot, L. Limon Promoted By Graver Water Conditioning

Graver Water Conditioning Company has announced the appointment of Harold R. Fosnot as assistant general sales manager and Leonard Limon as manager, sales engineering department. Fosnot holds degrees from Purdue University and the University of Chicago and came to Graver in 1935. During World War II, he served as an intelligence officer in Germany as a lieutenant Colonel.

Fosnot

Limon holds a chemical engineering degree from City College of New York and M.Ch.E. from New York University. Before coming to Graver in 1949, he served three and one-half years in the Navy as engineering officer of a minesweeper.

Three Minneapolis-Honeywell Branch Office Managers Named

Three new branch office industrial managers have been named for the Industrial division of Minneapolis-Honeywell Regulator Company. Robert M. Woodside was appointed branch industrial manager at Cleveland, John O. Paull, in Los Angeles, and Lee Aplin in San Francisco. All three men have been with Honeywell's Brown division for many years. Each is a graduate of the company's Instrumentation school at Philadelphia.

York Corporation Reelects Stewart Lauer President Again

Stewart E. Lauer, first elected president of the air conditioning and refrigeration firm in 1940, was re-elected president of York Corporation during the recent annual meeting of the company's board of directors.

At the same session the following officers were re-elected: J. Keith Louden, vice-president and assistant to the president; John G. Bergdoll, Jr., vice-president and production manager; John R. Hertzler, vice-president and general sales manager; Rodney F. Lauer, vice-president, engineering and research; Donald M. Magor, vice-president and controller; Marshall G. Munce, vice president, trade relations; and William F. Lynne, secretary and treasurer. Charles A. Barnes was re-appointed assistant secretary and assistant treasurer while Carl W. Fenninger, Jr., was re-named assistant secretary.

American Cyanamid Announces New Sales Service Department

American Cyanamid Company has announced the formation of a Sales Service department for its Industrial Chemicals Division. A. J. Campbell, general manager of the Division, explained that the move is in conjunction with a reorganization program, which has already consolidated various functions in the district offices. The new department will provide trade records, sales analysis, and complete order processing for the Division's main office. R. C. Sarfaty, who

formerly served as a product supervisor for Industrial's Heavy Chemicals department, was appointed manager of the new department. He is a graduate of Princeton and joined Cynamid in 1945.

Dr. William Ward Is Latest Beckman Staff Addition

Dr. William Ward, a native Chicagoan, has joined Beckman Instruments, Inc., as research-staff specialist in infrared instrument design. Ward's experience in infrared spectroscopy will be devoted to improving Beckman's line in this field of instrumentation. He was formerly a spectroscopist with The Texas Company in its research laboratory in Beacon, N. Y., and spent almost half of his six years there specializing in infrared research. Previous to this, Ward received his Ph.D. at Ohio State University after having completed his undergraduate work in chemistry at St. Benedict's College.

Ward

Celanese Corporation Sets Up International Organization

Celanese Corporation of America has established a new global organization known as Celanese Central, S.A. to provide closer liaison with the activities of foreign affiliates of the company in all countries except Canada. "During the past few years the size and scope of the activities of Celanese Corporation of America has substantially expanded," the company said, "with the result that management has been faced with constantly increasing duties. Interests in other countries have become so large and diverse that a continuing liaison with these countries is needed, particularly at this time when the difficulties of foreign trade are becoming more pronounced."

Kewanee Boiler, Ross Heater Combine To Form New Company

Kewanee Boiler Corporation and Ross Heater & Manufacturing Company, Inc., two divisions of American Radiator & Standard Sanitary Corporation, have combined to form a new company, Kewanee-Ross Corporation. Both units of the new firm will continue to operate as before, maintaining their respective plant locations, sales offices and representatives. Charles H. Currier, formerly president of Ross Heater has been named chairman of the board of directors of the new corporation, and W. Bradford Russell, formerly president of Kewanee Boiler Corporation, is president of the new firm.

Allied Chemical Consolidates Two Solvay Divisions Recently

The Solvay Process Division and the Solvay Sales Division have been consolidated and will be known as The Solvay Process Division, Allied Chemical & Dye Corporation. This division will be responsible for production and sale

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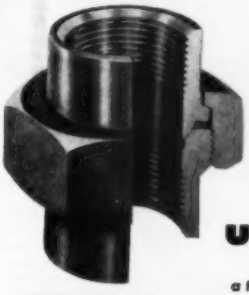

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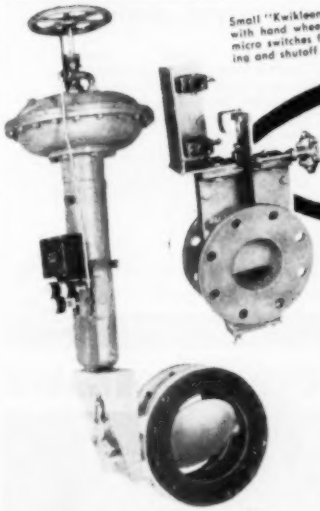

Small "Kwikleen" slide valve with hand wheel control and micro switches for flow starting and shutoff

Heavy duty butterfly valve with rubber-lined body and alloy trim for tight closure at 80 p.s.i., equipped with air diaphragm operator, valve positioner, pressure regulator and auxiliary handwheel.

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TIGHTNESS—commercial, drip tight or air tight construction to meet your needs.

PRESSURES—built rugged for operation at any pressure—even to 600 p.s.i., if necessary.

TEMPERATURE—as high as 2000° F.

RESISTANCE—valves made of any metal or rubber-lined for resistance to corrosion or abrasion.

CONTROL—lever, wheel, air diaphragm, air or hydraulic cylinder, electric motor, solenoid, float, etc.

SIZES—from 1" to 72" and larger.

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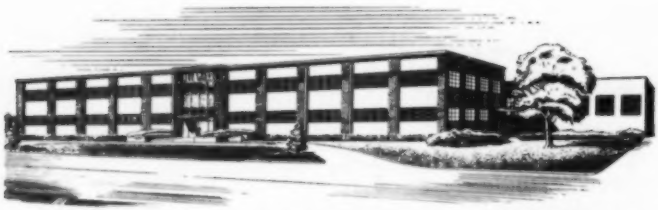
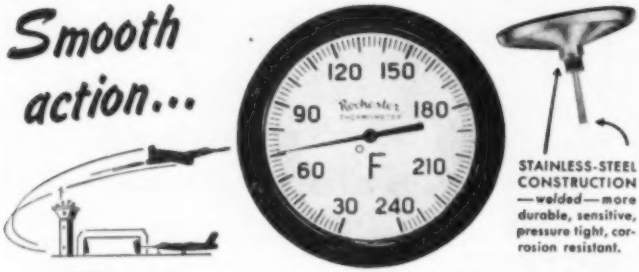


NEW GREER PLANT—The new home of J. W. Greer Company, pictured in the architect's drawing above, is now under construction about 15 miles from Boston and features some unique construction methods. Wall sections of the structure were cast of reinforced concrete while lying in a horizontal position on the building floor, and after hardening, were raised into position with a heavy crane. The new plant, scheduled for occupancy in June, will ultimately become the future home of the company, the site offering adequate space for expansion. The Greer Company produces continuous production machinery for high production wax moulding units.

Smooth action...



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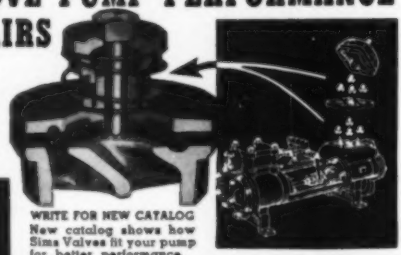
Replace those worn, leaky pump valves with long-life Sims Pump Valves. Better performance is guaranteed. (1) Discs rotate for uniform wear while cushioned top and bottom by the liquid. (2) Cushioned stem head and inclined ribbed seat combine to give smoother, faster valve action and take up shock.



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of alkali, chlorine and related products.

The Solvay Process Division will continue to sell the chlorine produced by the Nitrogen division. A. B. Chadwick now president of Solvay Process, will continue in that capacity and Charlton Bates will continue as vice president in charge of operations. H. F. Merritt, former executive vice president of Solvay Sales Division, takes over as vice president of The Solvay Process Division in charge of sales. L. B. Gordon, formerly vice president of Solvay Sales, becomes a vice president of The Solvay Process Division.

Hilding V. Beck Promoted By American Meter Company

The appointment of H. V. Beck as application engineer has been announced by the American Meter Company. He has been with the company for the past sixteen years and was the assistant manager of the company's metric works in Erie, Pa., prior to his present appointment. Before joining American Meter, he was an assistant professor at the University of Oklahoma where he was in charge of the ASME-O. U. Cooperative Fluid Meters Research Project. Beck is a mechanical engineering graduate of Yale University and a member of the ASME Fluid Meters Research Committee and the Instrument Society of America.

Beck

Drayer-Hanson, Inc., Purchases Jackson Engineering Company

Drayer-Hanson, Inc., manufacturers of air conditioners and refrigeration equipment, has completed the purchase of the Jackson Engineering Company, producers of aerial coolers and shell and tube heat exchangers for the petroleum and chemical industries.

Gordon M. Jackson will join Drayer-Hanson as vice president of the industrial division where he will have charge of the mechanical design, selection and sales engineering of all heat transfer equipment. The industrial division under Jackson will continue the manufacture of all former Jackson products.

Worthington Inaugurates New Engineer Placement Program

A new placement program for recruiting and training college-graduated engineers has been christened by Worthington Corporation with the signing of 52 engineers. The program is a part of a newly-created Personnel and Training department, organized under the direction of J. J. Thompson, manager. The new department absorbs the functions of the company's former Sales Personnel division and embraces recruitment, training, education, and development of new technical personnel for all branches of the company. The department also will be responsible for the administration of employment and personnel matters in connection with non-technical personnel in the company's district offices and headquarters departments.

Under the new program, 52 trainees

receive an intensive 12-month period of orientation and practical experience in all aspects of the company's activities.

A. J. Kerr, Rockwell Meter, Valve Vice President Resigns

A. J. Kerr, vice president, Meter and Valve Sales of Rockwell Manufacturing company, has resigned and is forming his own company to develop and sell products to the oil and gas industry. He is a mechanical engineering graduate of Carnegie Institute of Technology and was formerly a director of the American Society of Mechanical Engineers. He has been associated with Rockwell for 25 years and was recently cited for "outstanding service to the gas industry" by the Gas Appliance Manufacturers Association for his efforts as chairman of this group's gas meter and regulator division. He will be honored at their annual meeting in Colorado Springs.

Kerr

Johns-Manville Expanding Watson, California, Insulation Plant

A major expansion of the Johns-Manville plant at Watson, Calif., for the production of industrial insulation has been announced. Completion of the building to house the new manufacturing facilities is expected by early fall, 1953. The building will cover about 100,000 square feet of floor space. Company officials say the expansion is being undertaken to better serve industrial customers in the West Coast, Rocky Mountain and Southwest areas. Spokesmen also estimated that the addition will produce about $2.5 million of industrial products annually.

Construction Work Scheduled For American Can Company Plant

Construction work on the 56th manufacturing facility of the American Can Company is underway at Harrisburg, Pa. The new steel, concrete and brick structure, of the latest industrial one-story design, will be located on the 48-acre tract in LeMoyne Borough, just across the Susquehanna river from Harrisburg. The company purchased the tract about a year ago. The plant will cover approximately 275,000 square feet and is designed to permit future expansion. Completion of construction and installation of machinery is expected by the summer of 1953. Its rated capacity will be more than four million food cans per year.

Rust-Oleum Appoints 12 New Industrial Distributors

The Rust-Oleum Corporation has appointed 12 new industrial distributors in their nation-wide distributor organization. The new appointments include: Galen Paint Company, Toms River, N. J.; Metropolitan Paint Company, Washington, D. C.; Industrial Equipment & Engineering, Pittsfield, Mass.; Summers Hardware & Supply Company, Johnson City, Tenn.; Masek Auto Supply Company, Inc., Gering, Neb.; Masek Auto Supply Company, Inc., Casper, Wyo.; The Adkins & Douglas Company, Hur-

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are available in many types and sizes—all noted for their streamline coordination between impellers and shells.
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4—3000-B Manitowoc 50-ton Cranes, 120 ft. Jib
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lock, Md.; Stebbins-Anderson Company, Inc., Towson, Md.; Parsons Brothers, Inc., Bridgeport, Conn.; Carey Brothers, White Plains, N. Y.; M. A. Hartnett, Inc., Dover, Del.; and Superior-Sterling Company, Bluefield, W. Va.

Jack McKay Appointed Fluor Sales Promotion Manager

The appointment of Jack McKay as manager of the Sales Promotion department of The Fluor Corporation has been announced by company spokesmen. McKay will be in charge of advertising, publicity, exhibits and all phases of sales promotion. McKay joined Fluor in 1942 and for the past eight years has been directly connected with Sales, serving as sales engineer, assistant to the director of sales, and assistant district sales manager of Fluor's Houston district sales office for the past two and one-half years. He is a graduate of Oklahoma University with a degree in engineering.

McKay

District Sales Manager Named

Robert B. Bachman has been named district manager of sales of the Boston office of Lukens Steel Company. He succeeds Edmund Pfeifer who has been named district manager of sales, New York.

Texas Pipe Bending Company recently opened a new plant in Houston. Here is air-view of the setup. See item below.

Texas Pipe Bending Opens No. 2 Plant in Houston

The opening of Texas Pipe Bending Company's No. 2 plant and pipe yards in Houston recently has been announced by James A. Beeley, president of the firm. The 13-acre plant site is located at the intersection of the old Galveston highway and the LaPorte Expressway and is served by railroad trackage.

Texas Pipe Bending Company was founded by the late A. S. Beeley, who had been in the pipe fabricating industry for more than 40 years at the time of his death in 1950. The firm was moved to Houston 20 years ago, starting with an office and plant in Harrisburg. The original plant at 301 Frio Street has expanded to include large fabrication shops and a modern administration building. The new plant No. 2 will permit the company to carry a larger inventory of pipe and to increase production of the pipe bends, pipe coils and welded headers which it furnishes to the refinery, pipeline and petrochemical industries. Other officers of the firm are George E. Duckworth, vice president, and Raymond Beeley, secretary-treasurer.

In This Plant Nicholson Traps

SAVE 10% IN STEAM COSTS

Chief Engineer H.F.D. stated, after Nicholsons replaced mechanical traps in his plant: "Saving in steam waste cut our fuel cost at least 10%. Yet application temperatures were up 30°-40°. And relief of all air binding effected faster warm-up."

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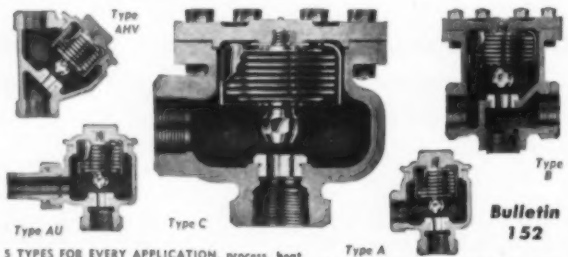

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Bulletin 152

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Hayes Joins Aluminate Staff As Technical Sales Representative

Edward R. Hayes, formerly with the Research department of the Standard Oil Company (Indiana), has recently joined the sales staff of the Catalyst Division, National Aluminate Corporation. He will serve as technical representative in connection with sales of Nalcat cracking catalyst to the petroleum refining industry. Prior to joining Indiana Standard, Hayes attended the University of Maine and Cornell University, receiving his M.S. degree in chemical engineering from Cornell in 1948.

Miller Named To Cleveland Office

Process Industries Engineers, Inc., has announced the appointment of Arch T. Miller as manager of their newly-opened Cleveland office. He previously sold process equipment in northwestern Ohio.

Lunkenheimer Receives Award At Purchasing Agents Show

The Lunkenheimer Company was one of two exhibitors receiving awards for the most informative displays at the 37th annual convention and Inform-A-Show of the National Association of

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LOW COST LIGHTING
for Gages, Rotameters, etc.
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Jerguson Illuminators use the principle of solid wedge lighting to give you *clear, even lighting, without bright spots.* Light flows through the plastic wedge and is reflected evenly. A single small bulb gives you better illumination at a cost so low that savings quickly pay for the illuminator.

Jerguson Illuminators are approved by Underwriters' Laboratories and are built in accordance with their Standard for Electric Lighting Fixtures for use in hazardous locations for Class 1, Group D Services. Made in a variety of sizes; also available in a non-explosion proof model.

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Purchasing Agents, held recently in Atlantic City, N. J. Exhibits sponsored by manufacturers were entered in the competition and judging was on the basis of the displays presenting the best, most helpful information to the 3100 purchasing agents who attended the convention.

Vulcan Copper & Supply Opens Branch Office In New York

The Vulcan Copper & Supply Company, engineers and manufacturers of

Drummond

Katzen

equipment and plants for the chemical and petroleum chemical industries, has announced the opening of a New York office to represent its engineering, manufacturing and construction divisions. V. D. Drummond, present manager of Vulcan Engineering Division, will become manager of the New York office.

Dr. Raphael Katzen will assume the position of manager of Vulcan Engineering Division to succeed Drummond.

Maintenance Engineering Elects R. A. Naylor, H. Park To Board

The election of Roger A. Naylor and Howard Park to the board of directors has been announced by Maintenance Engineering Corporation of Houston. Naylor, son of the Maintenance president, joined the company in 1951, after serving in the production department of Pan American Production Company. He is a graduate of the University of Texas. Park, a graduate of Rice Institute in mechanical engineering in 1942, joined the company in 1946, following a period with Bailey Meter Company.

Brown Appointed Assistant To Allegheny Vice President

Truman B. Brown has been named assistant to the vice president in charge of sales of Allegheny Ludlum Steel Corporation. At the time of his appointment to the newly-created position, he was district sales manager located in Detroit, Mich.

Ian R. Kiltie, a member of the Detroit sales staff was appointed district manager of sales succeeding Brown, and H. H. Lardin was named assistant manager.

Brown, a native of Brooklyn, N. Y., joined Allegheny Ludlum in 1934 and was named manager of the Detroit district in 1947.

Black, Sivalls & Bryson Opens Branch Office In Vernal, Utah

A new branch office has been opened by Black, Sivalls & Bryson, Inc. in Vernal, Utah, with Gerry Clayton as manager. This addition brings the total of BS & B branches and sales offices to 51.

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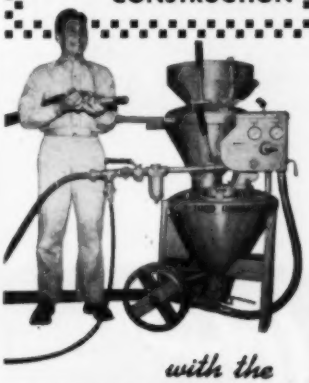

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Now Available...to fit your needs.
Model #1000-S requires 100 CFM at 90 p.s.i.
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Both units can be operated from either plant air or portable air compressors.

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NEW LABORATORY—Tennessee Eastman Company recently dedicated its new sales service laboratory building at Kingsport, Tenn. The laboratory building itself covers some 16,840 square feet and is divided into four major sections. One of the sections is devoted to assisting gasoline refiners in determining how the Tenamenes, Eastman gasoline additives, can be most efficiently used. The gasoline laboratory is organized to analyze all types of gasoline and to recommend sweetening and/or inhibiting procedures. An open house was held along with the dedication for the Northeast Tennessee Section of the American Chemical Society. Over 100 chemists and engineers visited the laboratories, examined the various equipment and discussed the work currently being carried on with Tennessee Eastman's staff of chemists and technicians.

Pittsburgh Coke & Chemical Elects Menke Vice President

Pittsburgh Coke & Chemical Company has announced the election of W. Kenneth Menke to the newly-created post of vice president in charge of chemicals. He will head the general administration of the company's expanding chemical activities. Before joining Pittsburgh Coke & Chemical, Menke had been with Monsanto Chemical Company for 17 years in various operating, research and administrative positions, the most recent having been director of Monsanto's development department. Menke received his degrees in chemistry and chemical engineering from Washington University.

ALCOA Elects Frank L. Magee As Director; J. R. D. Huston Retires

Frank L. Magee, vice president and general production manager of Aluminum Company of America, has been elected a director of the company by action of ALCOA's board of directors. At the same time, the board announced the retirement of J. R. D. Huston as secretary, a position he had held for the past eight years.

Alfred M. Hunt, a member of the board of directors, was elected to succeed Huston. Hunt has been assistant secretary since 1950.

O. R. Carpenter Made Executive Assistant At Babcock & Wilcox

The appointment of Otis R. Carpenter of the Barberton, Ohio, works of the Babcock & Wilcox Company as an executive assistant of the company has been announced. A graduate of Allegheny College, with a master's degree in physics from the Case Institute of Applied Science, Carpenter began work with the B&W laboratory at Barberton in 1933.

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For positions in Refinery Research and Development department, located in Tulsa. State qualifications and salary expected. Write Personnel Department, P. O. Box 381, Tulsa, Oklahoma.

Darbaker Named U. S. Steel Director Of Distribution

James M. Darbaker has been appointed Director of Distribution and Availability for United States Steel Company. In his new post, Darbaker will be responsible for planning the distribution of products manufactured by U. S. Steel.

A native of Vandergrift, Pa., Darbaker attended grade and high schools there, later attending the University of Michigan where he received a B. S. degree in mechanical engineering in 1920. He is a member of the American Iron and Steel Institute. Tau Beta Pi and Sigma Xi.

Holden Named Hooker Salesman

Hooker Electrochemical Company has announced the appointment of Herbert K. Holden as salesman in the Niagara sales territory, which comprises western Pennsylvania and New York state exclusive of the metropolitan area.

Allied Services Names Kaylo Heat Insulation Distributor

Allied Services, Inc., Charleston, W. Va., have been appointed distributor-applicator for Kaylo Heat Insulation by Owens-Illinois Glass Company. Principals in Allied Services are Conrad L. Wiegers, president and general manager, William D. Parks and L. S. Pennington, sales engineers. The company's president has been active in the insulation field for the past 22 years.

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in the July, 1952 issue of

Petroleum Refiner

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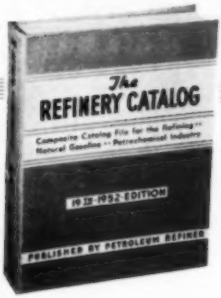

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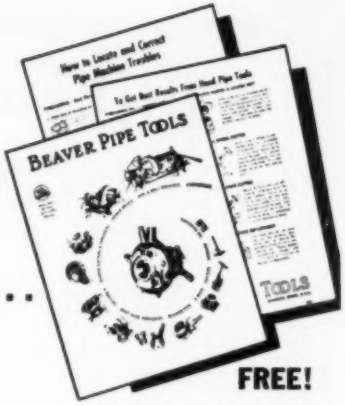

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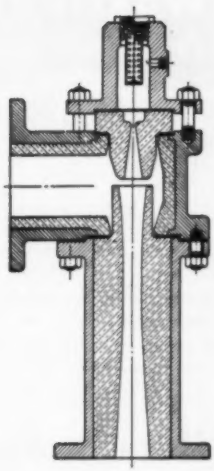

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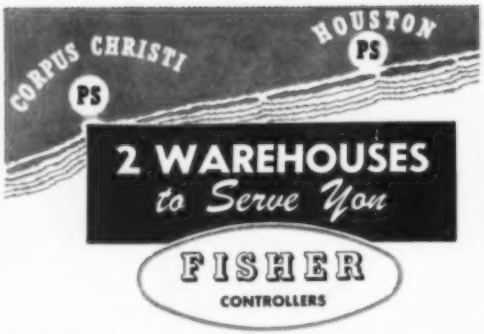

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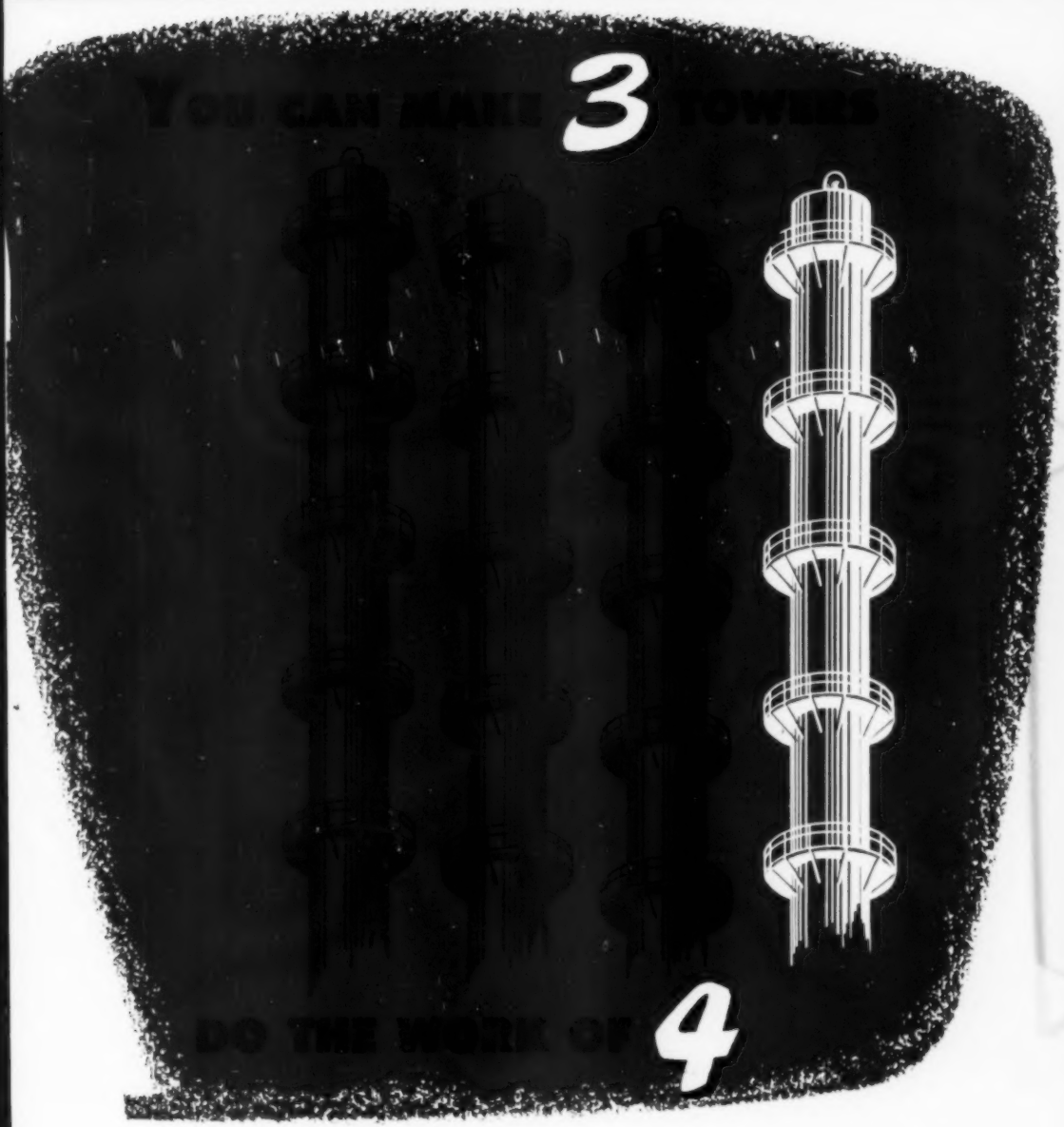

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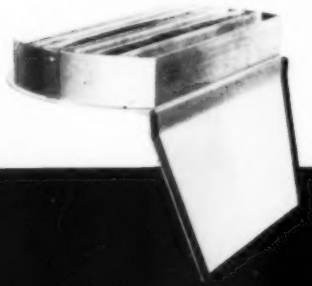

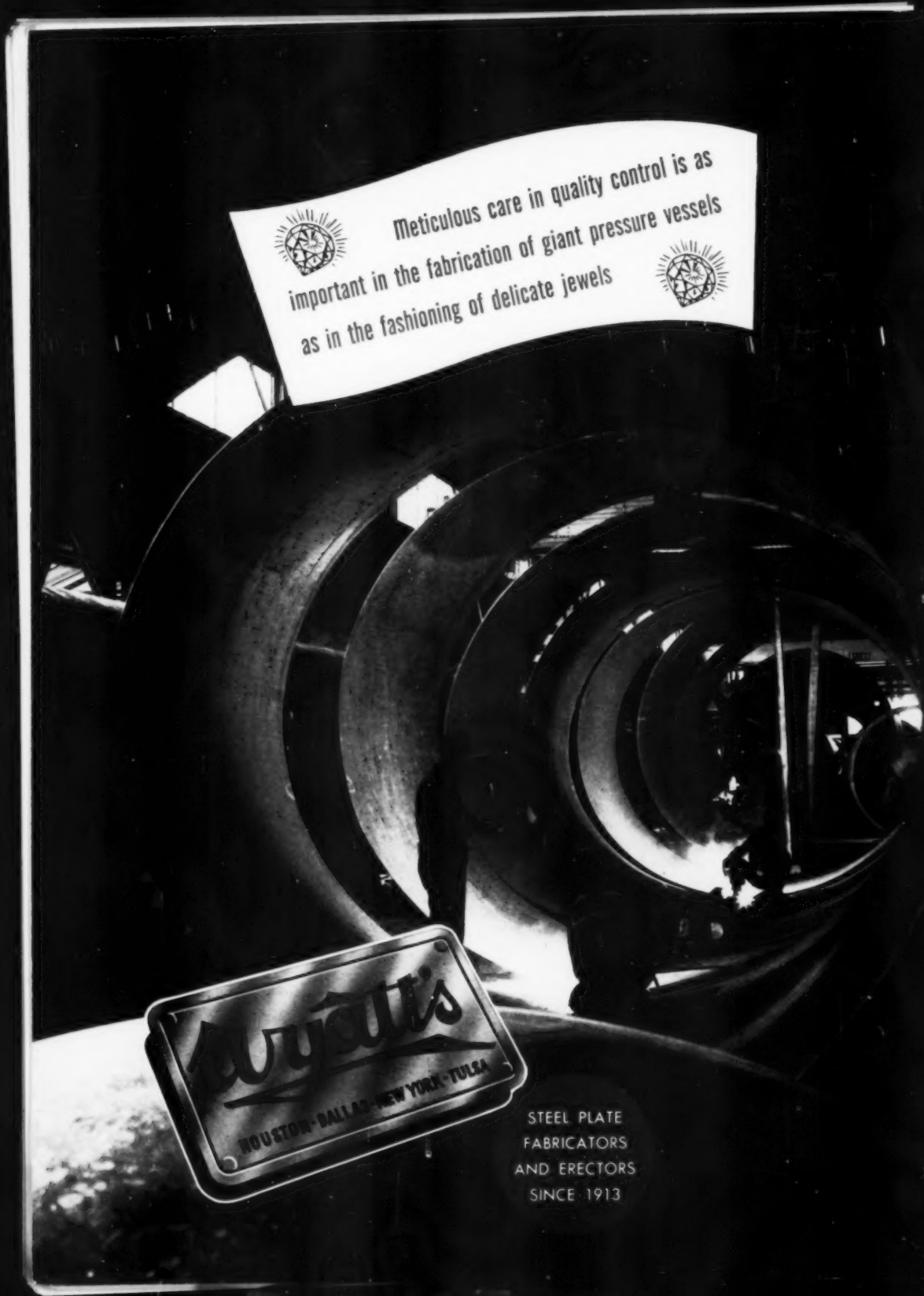
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